DRILLING AND PRODUCTION

PIPE LINE

REFINING NATURAL GASOLINE

Across the land and beyond our borders as well, in all oil producing areas, Tret-O-lite compounds are solving all emulsion problems quickly, effectively. And capable field engineers, always available, give speedy, accurate service when and where you need it.

Complete Service for Every Field

Tret-O-lite

REG. U. S. PAT. OFF.

DEHYDRATING **DESALTING**

Oil is Ammunition • Treat it Right

TRETOLITE COMPANY • *Manufacturing Chemists*

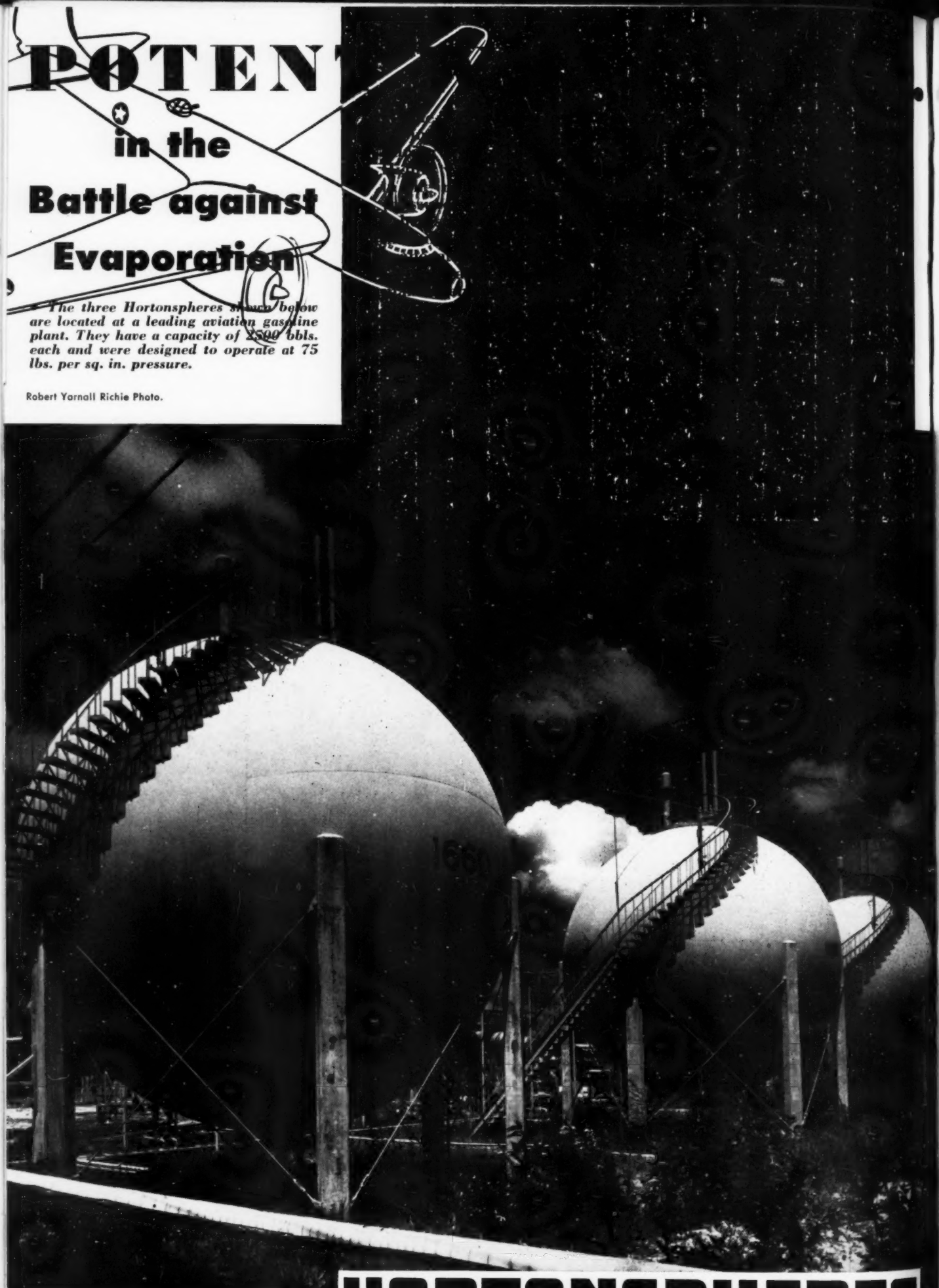
Webster Groves, St. Louis County, Mo. • Los Angeles, Calif.

POTENT

in the Battle against Evaporation

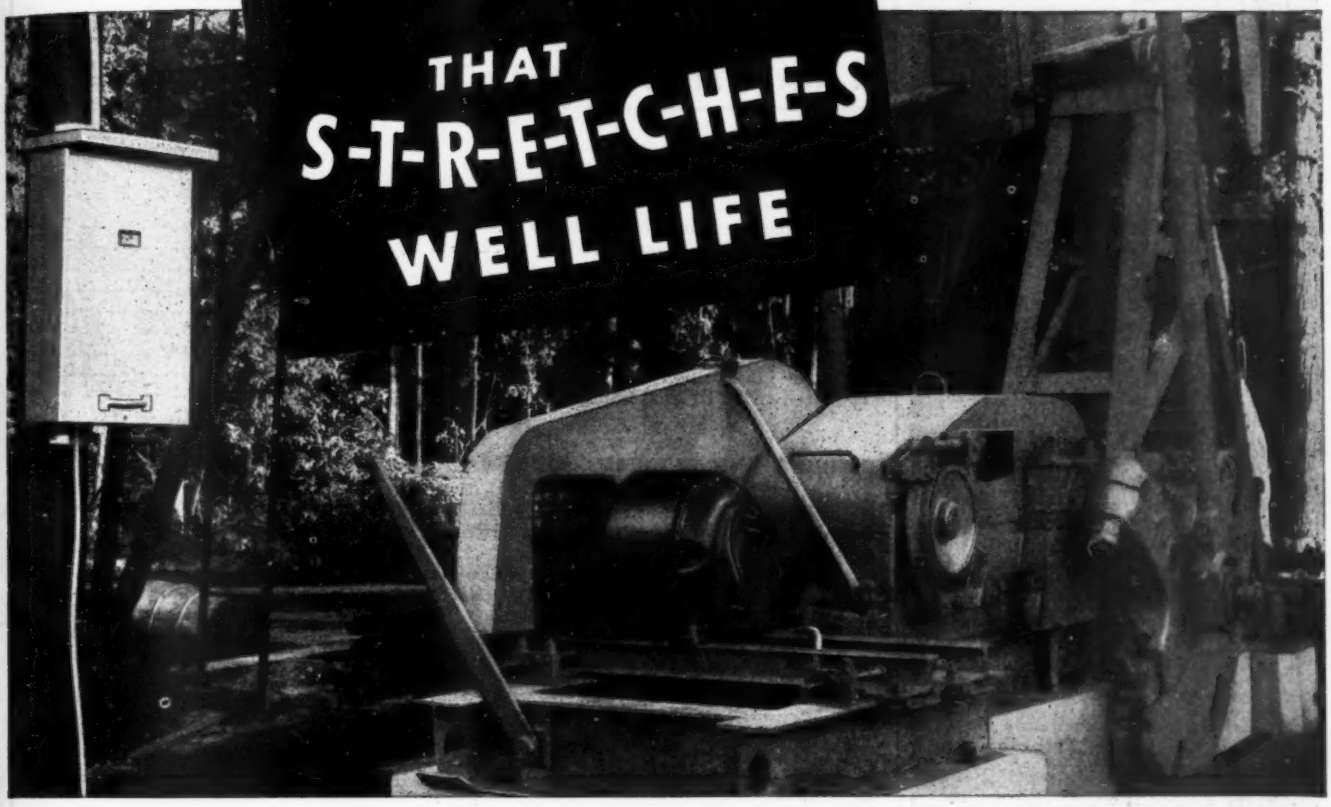
The three Hortonspheres shown below are located at a leading aviation gasoline plant. They have a capacity of 2500 bbls. each and were designed to operate at 75 lbs. per sq. in. pressure.

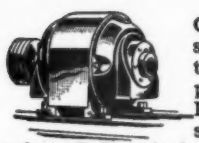
Robert Yarnall Richie Photo.



HORTONSPHERES

MPING THAT S-T-R-E-T-C-H-E-S WELL LIFE





G-E splashproof, squirrel-cage induction motor driving pump unit in Illinois. Frames and end shields of this and other G-E splashproof motors are of cast iron, to resist rust and corrosion. Coils are wound of tough Formex* wire, to forestall electrical failure.

CR7008 G-E combination starter for oil-well pumping. Time switch (accessible when outer door is open) controls periodic pumping. Inner door prevents access to "hot" parts. Magnetic starter has self-cleaning, self-aligning contacts; is long-lived, easy to maintain.

*Reg. U.S. Pat. Off.

WITH this new G-E motor-and-control team, you can coax along wells which do best when pumped slowly for long periods. You can step up the pace of those that can take it. In fact, you can tailor the pumping of any individual well to insure maximum life *and yield.*

You simply preset the proper pumping cycle on the G-E starter. Its built-in timing mechanism does the rest, automatically starting and stopping the pump. By eliminating the need for frequent supervision, this self-timing electric system affords substantial savings in man-hours.

From the standpoint of pumping life, G-E splashproof motors also offer this definite advantage: they possess electrical characteristics which act to cushion the shock and strain of reciprocating motion. Moreover, mechanically, these motors are well protected from wear, weather, and electrical breakdown.

G-E application engineers are ready to help you in selecting motors and control to fit your specific conditions. Call on them through the local G-E office. *General Electric Co., Schenectady 5, New York.*

Where purchased power is not economically available, isolated engine-driven G-E generators and a simple G-E power-distribution system will provide low-cost power for pump motors.

GENERAL ELECTRIC

65-1-27-188

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

MEETINGS

October 2-5—American Society of Mechanical Engineers, fall meeting, Cincinnati, Ohio.

October 3-4—American Association of Oilwell Drilling Contractors, annual meeting, Fort Worth, Texas.

October 3-5—National Safety Congress, Sherman, Morrison and La Salle hotels, Chicago, Ill.

October 5—American Gas Association, Engineering Societies' Building, New York City.

October 9-11—IPAA directors meeting, Dallas, Texas.

October 13—California Natural Gasoline Association, annual meeting, Biltmore Hotel, Los Angeles.

October 16-19—American Welding Society, annual meeting Hotel Cleveland, Cleveland, Ohio.

October 11-12—Indiana Independent Petroleum Association, Indianapolis.

October 23-25—National Lubricating Grease Institute, Edgewater Beach Hotel, Chicago, Illinois.

November 9-10—Society of Automotive Engineers, National Fuel and Lubricants, Mayo Hotel, Tulsa, Okla.

November 15-19—American Chemical Society, third national chemical exposition, Coliseum, Chicago, Ill.

November 27-28—South Dakota Independent Oil Men's Association, Mitchell.

January 8-12—Society of Automotive Engineers, annual meeting, Book-Cadillac Hotel, Detroit, Mich.

March 12-14, 1945—National Association of Corrosion Engineers, President Hotel, Kansas City, Mo.

★ The foreign-postwar planning issue of The Petroleum Engineer, which will be released in October, will have articles on the present oil situation in other countries and possible developments in the postwar period. There will be discussions on exploration, producing, and refining operations in other important oil areas outside the United States. Postwar planning in the oil industry will also be covered in the special issue.

★ ***Eden, Texas, citizens are unhappy over its new gas well, which produces 2,637,000 cu. ft. of natural gas a day. The town wanted water and hired a man to drill for it. He brought in this "dad-burned gas well."***

★ Record high production and depletion of stocks show up in the new graphic picture of the oil situation in this issue. If you want to learn about the nation's petroleum at a glance, turn to pages 14 and 15.

★ ***A series of vocational class proceedings on "Salt Water Disposal in East Texas" begins in this issue. The combined lessons will comprise an entire course in the subject.***

THE Petroleum Engineer

September, 1944
Vol. XV No. 13

A MAGAZINE OF METHODS FOR OPERATING MEN

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They have begun to FIGHT

Let's call him John Jones. Our John Jones has a fighting heart to match another of that name—John *Paul* Jones. But John hasn't a chance at a uniform. The doctors would laugh. The draft board would tell him to run along home. For John is 67.

Yet John Jones *is* fighting in this war. At 67, willing and skillful, he is doing a bang-up job in one of our company's war plants. He is one of many senior Standard Oilers who have earned retirement but are back on duty—*because there's a war on.*

Since they were young, these oldsters have worked toward independence. What's more, they *already had achieved it.* They had an assured income. Each was his own boss. Yet, *voluntarily,* they've gone back into harness—*to help along the war.*

Now, youth gives the most to war. But youth gives from morning of life. These others are giving the precious sunset hours. Such was the very spirit of the John Jones who signaled the enemy, "I have not yet begun to fight!" He didn't mean he hadn't started. He meant that, under fire, he would never quit!

To our own John Joneses special mention is due for their sacrifices to help on our vast war job.

Years ago, when this Company set up its retirement system, it was natural to think of it as something special for its people — which, of course, was true.

But so many of our retired employees have elected to serve instead of enjoying the relaxation and pleasures they had earned that we thought you would like to hear about it. This is the real American spirit that will win the war.

E flag, with 2 stars, awarded to our Richmond Refinery

STANDARD OF CALIFORNIA

The Course of Oil

K. C. SCLATER

BOOSTING ULTIMATE RECOVERY

For about five years now we have witnessed a serious lag in the discovery of new oil reserves in the United States. This has brought forth a flood of dire predictions concerning early exhaustion of the nation's liquid petroleum resources. Pessimism of this kind is not new to the industry; neither is it justified. Foremost authorities on oil resources show little concern over the nation's potential resources of oil; rather, inadequacy of existing oil-finding techniques is their concern.

Aside from new oil reserves, what of existing oil resources and the possibility of increasing their availability? We are too prone to underestimate the progress being made in improving methods of production to increase the rate and amount of ultimate oil recovery from fields now producing. It can be said of the oil fields developed to date, that more oil has been left in the ground than has been brought to the surface. Great strides are now being made in secondary recovery methods and intensive study is being given to this phase of operations. It is not too much to expect then, that a large proportion of the oil now left underground will eventually be recovered. As for fields yet to be discovered and developed, a much larger proportion of the original oil in place will be brought to the surface than in any fields developed to date.

Despite advances incorporating such practices as water flooding, gas repressuring, and pressure maintenance, much still can be done in old shallow fields. One example of the application of unconventional methods for obtaining more oil from an old shallow field that has been producing for years is the horizontal well project of the Venango Development Corporation at Two Mile Run, near Franklin, Pennsylvania. In this field, which has been producing oil for eighty years, remarkable increases in oil recovery have been obtained from horizontal wells recently drilled. In 1940 and 1941 oil production from a lease of 400 acres in this field from vertical wells was 1800 barrels a year, or about half a gallon per acre per day. During a period of six months it is reported that the average production from the horizontal well project is 28 gallons of oil per acre per day. This is roughly 56 times as much oil as the average produced from the vertical wells in 1940 and 1941. This increase in rate of recovery on the horizontal wells was obtained at a reported operating cost of about 15 cents a barrel, a figure much lower than that of the oil from the vertical wells. This gives us an inkling of what can and will be accomplished in augmenting the rate and amount of ultimate recovery not only from existing fields but from fields yet to be discovered.

WELL CORROSION MENACE

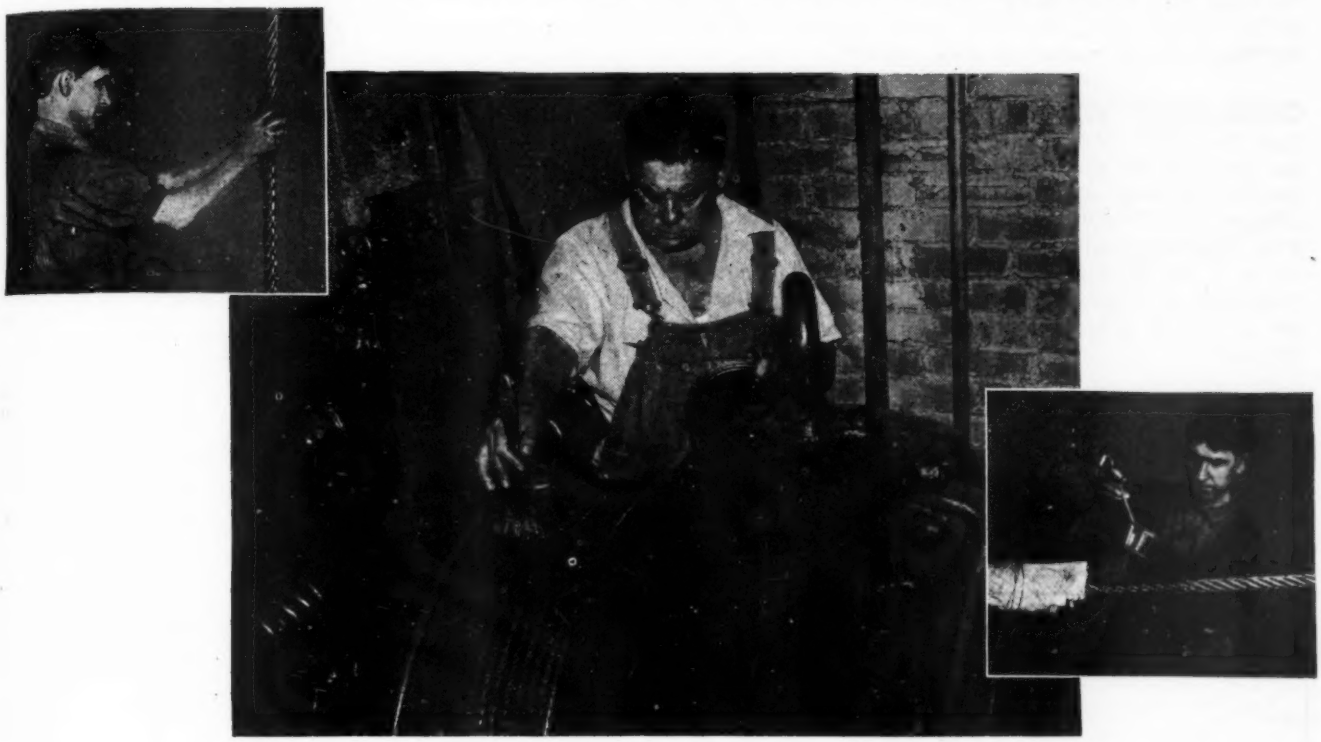
Evidences of severe corrosion have been observed on the inside surfaces of wellhead connections of condensate wells. How serious a problem this can become may be gathered from the fact that most condensate wells are operated under inordinately high pressure. Any weakness that may develop in the well casing or connections as a result of corrosion creates the menace of a blow-out. The difficulty of detecting corrosion makes the menace a hidden one, and unless precautions are taken and periodical checks made to ascertain the presence and extent of such corrosion, it may go unobserved until irreparable damage results. From a safety standpoint alone the necessity for eliminating the hazard of a blow-out is obvious.

The need for developing an effective method of combating such corrosion is immediate and imperative. To meet this need, a cooperative research project, having as its objective the determination of the causes and means of eliminating this corrosion, is being sponsored by the Natural Gasoline Association of America. It is announced that "a major portion of the research program has been placed with the staff of Battelle Memorial Institute, Columbus, Ohio, where Dr. H. A. Pray will conduct and supervise laboratory studies concerned with the metallurgical and chemical problems involved. Dr. Pray has just completed a tour of condensate producing areas in Texas and Louisiana where he observed the serious effects of corrosion and discussed with technical men the various efforts already made to combat it.

"Supplementing the work at Battelle Memorial Institute, it is planned to have full scale experiments carried on in the field by the staff of some southwestern institution as yet unselected. It is felt that this broad approach to the problems through both laboratory and field studies by independent agencies whose data and activities are correlated and supervised by a central research project committee will give the most comprehensive results in the shortest time. This committee will also serve as a clearing house for corrosion research data developed by individual companies and has arranged for cooperative exchange of information with the U. S. Bureau of Mines and the American Petroleum Institute."

Cooperative research of this kind is productive of the widest possible benefit to operator and to the industry at large. It will hasten the development of an effective method for overcoming a corrosion problem that also creates a serious operating hazard.

Longer Life through PROPER LUBRICATION



WIRE ROPE is continually fighting a battle-royal with corrosion, friction and wear. Because of the hazards involved, it is neither safe nor economical to use a rope whose original strength has been reduced (by either corrosion or wear) to a point where it no longer affords an adequate factor of safety.

But the safe life span of a wire rope can be greatly extended by keeping it correctly lubricated at all times. The lubricant applied during manufacture will not last indefinitely.

The greatest harm resulting from incorrect or insufficient lubrication is the rust and decay that takes place within the rope. For the most part corrosion is an "undercover" worker as its action is not always visible until too late.

Friction and wear fight hand in hand. Their attack is within *and* without. Every time a wire rope bends there is a sliding movement of both wires and strands where they contact one another. There is also friction where the rope comes in contact with the sheaves and drum.

Proper lubrication will help wire rope win its battle for Longer Life as it lessens friction, promotes flexibility, reduces wear and retards corrosion. The right kind of lubricant to use and the frequency with which it should be applied, depend upon the conditions under which the rope is operating. We shall be glad to give further details on this important subject.

Important: **An idle wire rope is more vulnerable to corrosion than one in use. So be sure to give your ropes the protection of a good lubricant when they are not in service.**

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U. S. A.

NEW YORK . . . 90 West Street
CHICAGO . . 810 W. Washington Blvd.
DENVER . . . 1554 Wazee Street

"HERCULES" (RED STRAND) WIRE ROPE

SAN FRANCISCO . . 520 Fourth Street
PORTLAND . . 914 N. W. 14th Avenue
SEATTLE . . 3410 First Avenue South

National Petroleum Situation

PRODUCTION UP 14 PER CENT. Daily crude production in the United States in the first 8 months of this year was 542,000 barrels above last year; a gain of 14 per cent. Texas accounted for 513,000 barrels of the total increase; 94 per cent of the national gain. California, Louisiana, Arkansas, and New Mexico recorded a combined gain of 97,000 barrels daily. All other states showed a combined decrease in crude output of 68,000 barrels.

CRUDE SHORT 20 MILLION BARRELS. Refining operations have been stepped up 731,000 barrels a day over last year; 20 per cent above 1943. Thus, despite the tremendous increase in crude production, supplemented by unknown quantities of foreign oil imported and processed, it has been necessary for the industry to draw upon crude stocks to the tune of 20 million barrels since January 1. Producing and refining operations have lagged about 4 per cent under actual requirements in the first 8 months of this year.

STOCKS TOO LOW. The combined stock position of the industry stood at 82.3 per cent of normal at the close of August. Stocks of crude and products are about 100 million barrels below working levels made necessary by war. While motor fuel stocks are 8 million barrels above last year the current supply is actually one day less than last year. Fuel oil supplies are now at the same level as last year, 52 days, which makes it evident that the industry's ability to meet the coming winter demand is no better than last year. An immediate easing up in military distillate demand is expected, however, to release additional distillate supplies for domestic use.

MORE DRILLING. New drilling operations are 51 per cent above last year but gains of 31 per cent and 15 per cent respectively in development and wildcat drilling this year have failed thus far to uncover any unusual new sources of oil supply. Wildcatting results in the first 8 months contributed only 18 additional oil wells over last year. Few of these have been of major importance, so that the discovery picture continues unsatisfactory.

MORE OIL FOR JAP WAR. A suddenly disjointed petroleum industry, with the end of the war in Europe, is not expected. Much of the petroleum supply now moving across the Atlantic will be diverted to the Far East for the finish fight with Japan. Talk of thousand plane raids over Japan and combined Allied concentration upon vast Jap-held Chinese territory points to continued astronomical war demands for petroleum and its products. ★★★

Comparative Statistics, August, 1944

*All figures are computed on a Bureau of Mines basis.**

	August 1944(p)	July 1944(p)	August 1943	This year to date	Last year to date	Per cent change
Wells drilling	4,210	4,130	2,788	4,210	2,788	+51
Total wells drilled	2,086	1,985	1,609	14,002	10,983	+ 27
Development wells	1,713	1,611	1,225	11,499	8,801	+ 31
Oil	1,161	1,101	774	7,980	5,716	+ 40
Gas	186	214	150	1,356	1,083	+ 25
Dry	366	296	301	2,163	2,002	+ 8
Per cent dry	21.4	18.4	24.6	18.8	22.7	— 3.9
Wildcat wells	373	374	384	2,503	2,182	+ 15
Oil	40	49	53	300	282	+ 6
Gas	9	6	8	78	38	+105
Dry	324	319	323	2,125	1,862	+ 14
Per cent dry	86.9	85.3	84.1	84.9	85.3	— 0.4
Crude production	146,115	144,050	130,633	1,103,505	967,468	+ 14
Daily average	4,713	4,647	4,214	4,523	3,981	
Crude stocks	230,015	232,600	246,294	230,015	246,294	— 7
Days supply	46	48	56	46	56	
Crude demand†	153,590	150,300	135,649	1,142,338	977,695	+ 17
Daily average	4,955	4,848	4,376	4,682	4,023	
Natural gasoline production	‡8,445	‡8,470	7,601	‡65,843	58,958	+ 12
Daily average	272	273	245	270	243	
Motor fuel production	63,090	63,260	54,031	481,465	385,981	+ 25
Daily average	2,035	2,041	1,743	1,973	1,588	
Gasoline yield, per cent	38.4	39.5	37.3	38.8	36.5	+ 2.3
Motor fuel stocks	73,375	74,300	65,557	73,375	65,557	+ 12
Days supply	35	36	36	35	36	
Motor fuel demand	64,015	63,683	56,293	477,448	389,929	+ 22
Daily average	2,065	2,054	1,816	1,957	1,605	
Fuel oil stocks	94,620	88,360	93,788	94,620	93,788	+ 1
Days supply	52	47	52	52	52	
Fuel oil demand	56,835	57,750	55,713	485,400	417,678	+ 16
Daily average	1,833	1,863	1,797	1,989	1,719	
Refinery runs	145,245	143,025	126,908	1,098,130	916,085	+ 20
Daily average	4,685	4,614	4,094	4,501	3,770	
All refined stocks	250,300	242,360	229,058	250,300	229,058	+ 9
Days supply	53	51	52	53	52	

*Unless otherwise stated, all figures represent thousands of barrels.
‡Includes benzol. †Domestic and foreign.

Economic Position of Petroleum Industry

First eight months, 1944.

	Normal	Actual	Per cent of normal
Drilling (wells completed)	15,290	14,002	91.6
Production (daily average)	4,730	4,523	95.6
Refining (daily still runs)	4,660	4,501	96.5
Stocks (crude and refined)	583,000	480,315	82.3
Price of crude oil, per bbl	$1.93	$1.22	63.2

Crude Prices by States for August, 1944§

U. S. average	$1.22	Louisiana	$1.20
Texas	1.23	Arkansas	1.25
California	1.07	New Mexico	1.04
Oklahoma	1.17	Mississippi	1.10
Kansas	1.17	Illinois	1.37
		Other States	1.89

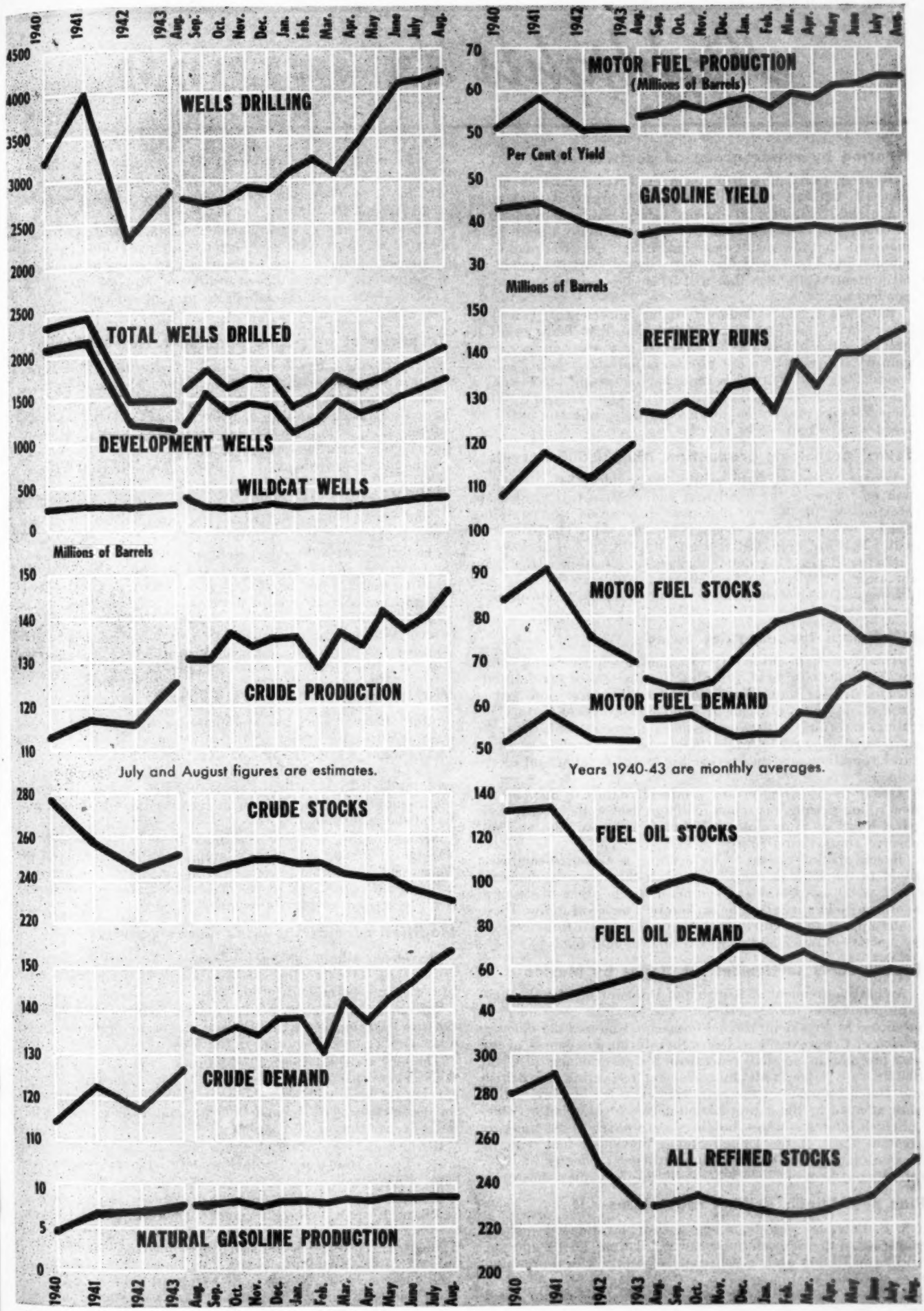
Basic crude prices

Oklahoma-Kansas (36 gr.)	$1.17
Texas Gulf Coast (36 gr.)	1.40
East Texas	1.25
West Texas (36 gr.)	1.04
Calif., Signal Hill (26 gr.)	1.11
Pennsylvania Bradford	3.00

Drilling and Production Statistics by States

	August 1944(p)	July 1944(p)	August 1943	This year to date	Last year to date	Per cent change
Total wells drilled	2,086	1,985	1,609	14,002	10,983	+ 27
Texas	565	517	386	3,605	2,571	+ 40
California	168	169	136	1,285	861	+ 49
Oklahoma	155	150	119	1,051	757	+ 39
Kansas	171	182	143	1,195	1,048	+ 14
Louisiana	71	74	56	491	440	+ 12
Arkansas	41	38	26	207	163	+ 27
New Mexico	29	26	22	263	142	+ 85
Mississippi	4	16	3	81	55	+ 47
Illinois	171	163	148	1,129	1,125	0
Other states	711	650	570	4,695	3,821	+ 23
Wildcats drilled	373	374	384	2,503	2,182	+ 15
Texas	136	119	123	900	736	+ 22
California	12	36	21	143	134	+ 7
Oklahoma	32	37	36	229	203	+ 13
Kansas	46	44	50	335	308	+ 9
Louisiana	6	10	11	85	84	+ 1
Arkansas	12	5	8	46	49	— 6
New Mexico	6	1	9	45	36	+ 25
Mississippi	5	13	3	56	20	+180
Illinois	44	42	55	242	294	+ 18
Other States	74	67	68	422	318	+ 33
Daily crude production	4,713	4,647	4,214	4,523	3,981	+ 14
Texas	2,130	2,087	1,727	2,002	1,489	+ 34
California	862	858	779	838	774	+ 8
Oklahoma	341	343	332	336	339	— 1
Kansas	277	312	286	278	299	— 7
Louisiana	359	340	343	352	333	+ 6
Arkansas	82	80	76	80	74	+ 8
New Mexico	106	108	106	110	102	+ 8
Mississippi	45	43	51	43	54	— 20
Illinois	206	215	216	214	228	— 6
Other States	305	261	294	270	289	— 7

(p)—Preliminary.
§No change since prices frozen. Prices do not include subsidies.


1940
1941
1942
1943
Aug.
Sep.
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
WELLS DRILLING
4500
4000
3500
3000
2500
2000
MOTOR FUEL PRODUCTION
(Millions of Barrels)
70
60
50
Per Cent of Yield
GASOLINE YIELD
50
40
30
TOTAL WELLS DRILLED
DEVELOPMENT WELLS
WILDCAT WELLS
2500
2000
1500
1000
500
0
Millions of Barrels
REFINERY RUNS
150
140
130
120
110
100
CRUDE PRODUCTION
150
140
130
120
110
MOTOR FUEL STOCKS
MOTOR FUEL DEMAND
90
80
70
60
50
July and August figures are estimates.
Years 1940-43 are monthly averages.
CRUDE STOCKS
280
260
240
220
FUEL OIL STOCKS
FUEL OIL DEMAND
140
120
100
80
60
40
CRUDE DEMAND
150
140
130
120
110
NATURAL GASOLINE PRODUCTION
10
5
0
ALL REFINED STOCKS
300
280
260
240
220
200

Highlights IN OILDOM

Hearing by House group on postwar oil

Representative Wright Patman of Texas, chairman of the House Committee on small business, has arranged for a meeting of his committee at Austin, Texas, on September 20 to discuss postwar problems of oil producers. Representative Patman says that talks with members of the Texas Railroad Commission have convinced him that reduced market demand for oil presents a problem that will be serious for the small independent operator.

Patman's statement followed an announcement by Ernest O. Thompson, a member of the commission, that Texas needs to prepare immediately for the shock of reconversion in the oil industry. Oil men who are producers only have been "selling goods off the shelf" at below reproduction cost on a fixed ceiling price but with increased operating cost, Thompson said. When their volume production disappears these operators will be faced with difficulties, he stated.

Texas' petroleum production 700,000,000 barrels

George Sheppard, state comptroller, reports that oil production in Texas for the fiscal year ended August 31 totaled approximately 700,000,000 bbl., with production taxes totaling $34,459,061, or $9,161,903 more than last year. This compares with 525,102,523 bbl. last year and 499,918,556 bbl. in 1939-40.

Sheppard also gave notice that pending further advice from the attorney general his department is applying the state production tax against the federal subsidy payment to low-producing oil wells.

Mississippi spacing rules eased

The Mississippi Oil and Gas Commission has issued a ruling for the Heidelberg field, providing for division of the field into 20-acre drilling units, but with the further provision that at present only one well can be drilled to every 40 acres. This ruling, according to the commission's announcement, is for the purpose of allowing operators to take better advantage of structural conditions and to provide for future development of the field.

Due to the apparent erratic producing nature of the field the new ruling permits operators drilling offset wells to shift their offset locations to as close as 330 ft. to property lines and still observe conservation rules.

Recent drilling seems to be defining a northeast-southwest trend to the field in comparison with the formerly theorized trend to the northwest and southeast. As in other Mississippi pools, the field appears to be broken by a series of faults. These faults appear to parallel each other rather than to be crossed by a series of other faults, as was first thought likely.

Expect early settlement oil claims by Mexico

An early settlement of British and Dutch claims for the 1938 expropriation of oil properties by the Mexican government is predicted by President Manuel Camacho, who told the opening session of Congress: "I feel sure that during the course of the next few months we shall reach with the governments of Great Britain and Netherlands an agreement respecting the British and Dutch interests in the petroleum industry of Mexico that were affected by the expropriation decree of March 18, 1938."

British interests, whose holdings were nearly three times as great as those of the United States, previously had rejected Mexico's terms. The United States settlement, effected in 1943, calls for payment of $23,995,991 to the oil companies concerned.

Plan new Illinois drilling regulations

S. F. Peterson, petroleum engineer of the state oil and gas conservation division, outlined new regulations for oil and gas drilling in Illinois after a conference recently with representatives of oil and coal operators.

Approved proposals, to be made effective sometime the latter part of September, are stated by Peterson to be as follows:

Permits for drilling oil wells may be transferred without the $10 fee if to a location on the same lease and not exceeding 1320 ft. from the original location.

Owners of unused drilled wells must show cause at a public hearing why the wells should not be plugged and abandoned.

Bases beneath dry holes offsetting coal seams in mines must be substantially strengthened to prevent slipping.

Strengthening of regulations to prevent avoidable waste of gas.

To prospect on public domain in New Mexico

An agreement has been reached between the U. S. Department of the Interior and the State of Mexico, permitting Stanolind Oil and Gas Company to prospect for oil in the 20,471-acre Picacho unit area in Lincoln County. About 52 per cent of this area is land in the public domain and is under the jurisdiction of the Department of the Interior. The rest is owned by the State of Mexico and by private individuals.

Hearing on Anglo-American agreement postponed

The Senate Foreign Relations Committee has decided to postpone hearings on the recently negotiated Anglo-American oil agreement until after the November election, it is announced by Chairman Tom Connally of Texas. In a statement, Connally asserted that it would be difficult to conduct a public inquiry in the absence of a quorum of members. President Roosevelt recently sent the agreement to the Senate in the form of a treaty, which will require ratification by two-thirds of the Senate's members. Connally said the committee voted the postponement in view of the probable recess of Congress.

Water injection recovers 4,000,000 bbl. oil

More than 4,000,000 bbl. of oil have been recovered in Kansas since 1936 as the result of the injection of about 41,000,000 bbl. of water, a ratio of 1 bbl. of oil to 9.66 bbl. of water, according to a report by the U. S. Bureau of Mines in cooperation with the Kansas State Board of Health. Peter Grandone, petroleum engineer for the Bureau at Bartlesville, Oklahoma, prepared the report.

Water-flooding began on a planned basis in Kansas with the passage of a state law in 1935 authorizing this method of recovery. By 1936 three projects had demonstrated the practicability of the method and by November, 1942, water-flooding was being practiced in thirteen counties.

Modified regulations in 42 Texas counties

Petroleum Administration for War has modified well-spacing regulations for 42 counties in North and West Central Texas, in a move to increase oil production.

Effective immediately, wells may be drilled to any one of the specified depth ranges without regard to wells drilled to other depth zones, according to the order.

The new order establishes the following well-spacing regulations: 5-acre spacing for wells drilled to 1400 ft. or less; 10-acre spacing for depths between 1400 and 2500 ft.; 20-acre spacing for depths between 2500 and 3400 ft.; and 40-acre spacing for wells deeper than 3400 ft.

Requirements regarding distance between wells and the distance of wells from property lines are left to the state regulatory body, PAW said.

Counties affected by the new order are Archer, Baylor, Brown, Callahan, Clay, Coleman, Comanche, Concho, Cooke, Coryell, Denton, Eastland, Erath, Fisher, Foard, Grayson, Hamilton, Hardeman, Haskell, Hood, Jack, Jones, Knox, Lampasas, McCulloch, Mills, Montague, Nolan, Palo Pinto, Parker, Runnels, San Saba, Shackelford, Somervell, Stephens, Stonewall, Taylor, Throckmorton, Wichita, Wilbarger, Wise, and Young.

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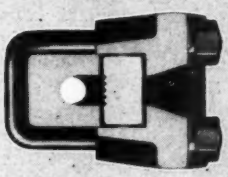

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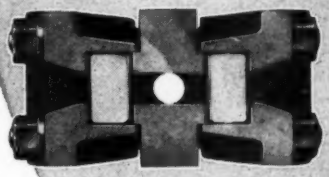

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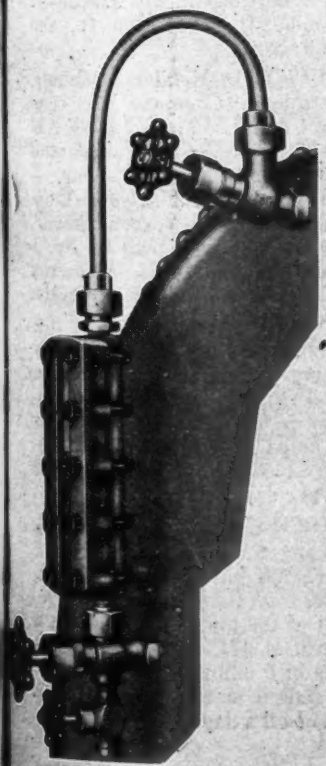

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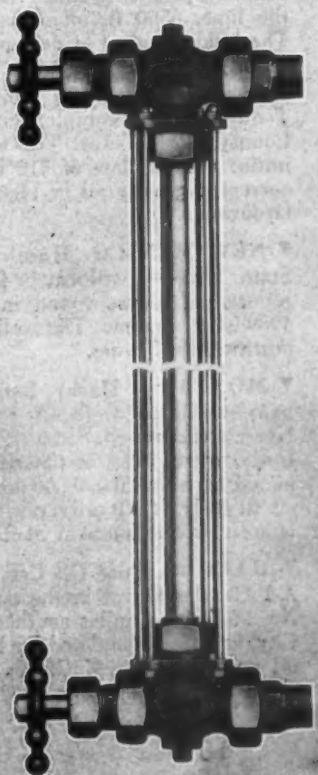

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PENBERTHY PRODUCTS

MAJOR *Oil Field* ACTIVITIES

▼ **TEXAS.** Merry Brothers and Perini and Adler Oil Company No. 1 Herndon, 6 miles southwest of Anson, Jones County, is estimated to be good for 1000 to 1600 bbl. of oil daily. Production is from the Flippen lime, the chief pay in the Royston and Reddin fields and found also in the Wimberly. The well is located 720 ft. from west line and 330 ft. from south line in the 372-acre J. N. Herndon tract, section 19, block 2, S&S survey. It is believed to be a heavier producer than the discovery well of the Wimberly field and of the Hardy, two fields with high productions.

Lyons and Prentiss No. 1 Keenan Estate, Victoria County, wildcat on the Martin de Leon survey, is flowing about 200 bbl. of oil per day at 4754-58 ft. The well is situated near the Jackson County line and north of the Keenan field.

Phillips Petroleum Company has opened a new Permian lime oil pool in southern Andrews County, with its No. 1-H University, 3 miles north of the North Cowden pool. The well was completed from the San Andres lime for daily potential of 120 bbl., with a total depth of 4717 ft.

Panhandle Refining and Anderson-Prichard uncovered a new Caddo field in Throckmorton County, 6 miles northeast of Throckmorton. The strike is the No. 1 W. B. Ewalt, block 2170, T. E. and L. survey, producing in lime. Total depth is 4167 ft. Initial tests uncovered 375 ft. of free oil and 200 ft. of heavily saturated mud.

Continental and Edge Oil Company has completed its No. 1 W. D. Crockett, block 3245, T. E. and L. survey, east of Buffalo Springs, good for 120 bbl. from the lime, 6560 ft. on commission test. The wildcat opens a new pool in Clay County.

Amerada Petroleum No. 5-A J. S. Todd has been completed in Crockett County, West Texas. The well had an initial natural flow of 312 bbl. of 41.3 corrected gravity oil in 14 hr. from the Ordovician.

▼ **NEW MEXICO.** Humble No. 1-0 State, 1-12s-34e, wildcat in Lea County, reports oil shows found in a core at 4989-94 ft. in lime. The well is 8 miles northwest of Tatum.

▼ **MONTANA.** Husky Refining Company's wildcat well on the Kicking Horse structure opened a new gas field. Initial production for the well was estimated at from 20,000,000 to 50,000,000 cu. ft. daily. It is 8 miles northeast of the nearest production near Shelby.

▼ **ILLINOIS.** Pure Oil Company's No. A-1 Charles Guyat in the SW SW SW No. 36-3n-8e, 4 miles southeast of Clay City, has been completed for 1100 bbl. of oil per day from McClosky limestone. Total depth of the hole is 3105 ft. with pay found in 3 breaks, 2969-75, 2995-99 and 3019-23 ft.

The Weller-Randall and Schoonmaker No. 1 United States Coal and Coke in NW SW SW No. 15-5s-2e indicates a good oil producer. It is located 6 miles northwest of Benton in Franklin County, and is producing from the Aux Vases sand at 2669-79 ft.

Magnolia Petroleum Company has announced the opening of a new oil field in Clay County, north of Clay City, with its No. 1 Mary Rinnert, 33-4n-SE. The well pumped 43 bbl. of oil, no water, from the Cypress sand on a 24-hr. test. Total depth of the well is 2700 ft.

▼ **MICHIGAN.** Chapman Oil Company's No. 1 Telzlaff, S ½ NW SW, 4-15n-9w, Colfax township, Mecosta County, opens a new oil pool. It is producing in Monroe lime at 3560-3615 ft.

▼ **KANSAS.** Sedgwick County gained another oil pool with the opening of the No. 1 Minnie Sautter, in the SE SE NE 22-29-2w, ¾ mile from Clearwater. Opened by Leo Wentworth and others, the well is producing from the Kansas City lime at 100 bbl. per day.

Lion Oil Refining Company has reported a strike in Kiowa County. It is the No. 1 Alford in the SE SE SW 14-30-19w, 20 miles southwest of Coats in Pratt County. Depth is 5040 ft.

Sunray Oil Company has opened a new pool 9 miles west of Hays, Ellis County, with its No. 1 Orth, NE NE SW of 2-14-20. Production is from the Reagan sand; total depth of the well is 3852 ft. It swabbed 162 bbl. of oil per hr.

▼ **OKLAHOMA.** Carter Oil Company has opened a new Wilcox sand oil pool in McClain County with its No. 1 Johnson, CSW SE 30-8-2w. Total depth of the well is 8214 ft. and on an initial test flowed oil at the rate of 15 bbl. per hr. The well is 3½ miles northeast of the company's No. 1 Cottingham, which made 200 bbl. a day from the Wilcox sand at 10,645 ft.

New pool for Wyoming

Development of a new oil field in Wyoming was assured with announcement by Continental Oil Company of the discovery of a new and deeper oil sand in the new Gebo pool, Hot Springs County. Continental's Gebo Unit No. 3 flowed 1402 bbl. of 26-gravity oil from the Tensleep sand, in the first test made of this structure in the area, according to W. C. MacMillan, vice president in charge of production. Production in the Tensleep is from 4880 to 4983 ft.

Continental, which had previously drilled two wells in the Gebo pool, producing from the Embar lime from 4680 to 4968 ft., has a solid block of 6240 acres under lease.

Sinclair Prairie Oil Company No. 1 Allred, in NE NW SE of 20-3n-3e, is a possible new pool opener for Garvin County. On drillstem tests from 1890 to 1909 ft., with tester open 30 min. it showed 1030 ft. of oil and 15 ft. of oil-cut mud.

Nadel and Gussman and Olson Oil Company No. 1 Sandlin, SEC NW 6-14n-8e, 5 miles south of Depew, in Creek County, has been completed on production in Prue sand from 2450 to 2468 ft. On a 9-hour pumping test the well produced 27 bbl. of oil and 100,000 to 150,000 cu. ft. of gas.

▼ **NEBRASKA.** The Texas Company has erected a derrick for the No. 1 Taunton, NW NE NW of 22-2s-35w, 1½ miles southwest of Stratton, and north of the Rawlins County, Kansas, line. This test is the beginning of a development program to prove the large block of acreage the company has in Hitchcock County. Sinclair Prairie Oil, Magnolia Petroleum, and the Stanolind Oil and Gas companies also have considerable holdings in this general area.

▼ **MISSISSIPPI.** Prospects for a new field in Mississippi were high with the completion of the California Company W. C. Douglas No. 1 in Lincoln County, about 6 miles southeast of Brookhaven. The well flowed approximately 11 bbl. of oil per hour through a 5/32 in. choke. It was perforated between 10,514-48 ft.

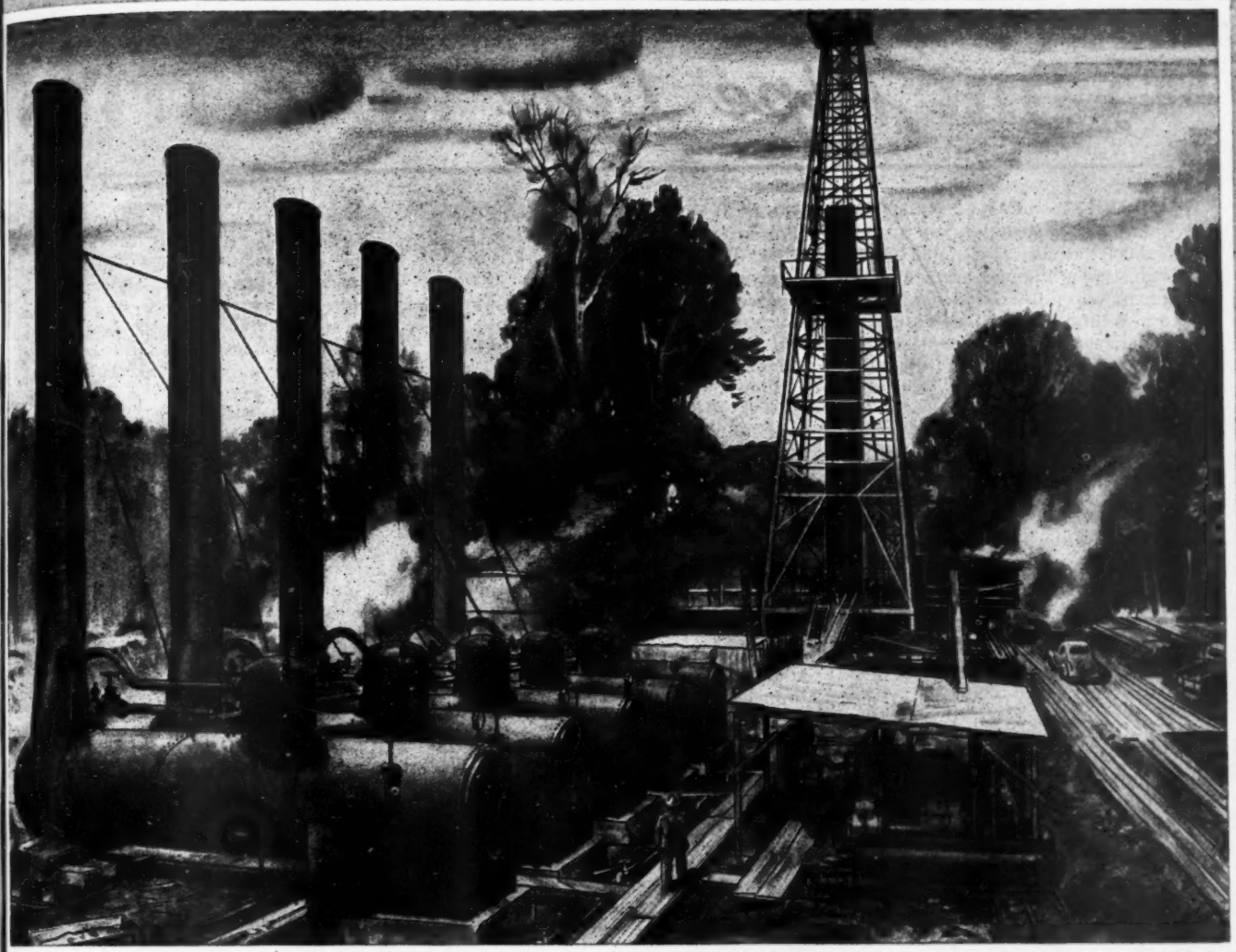
Sid Richardson of Fort Worth has struck a new gas-condensate pool in Jeff Davis County, in the south central part of the state. The new discovery, good for 100 bbl. of condensate daily, is producing from 3 horizons in the Tuscaloosa sand, 7855-80 ft., 8075-8106 ft., and 8210-32 ft.

▼ **KENTUCKY.** In Henderson County, Sohio Petroleum Company has completed No. 1 Ann L. Porter, NE NE NW No. 204-0-24, in the Pennsylvanian sand from 490-660 for 60 bbl. of oil a day.

National Associated Petroleum Company of Tulsa and Mt. Vernon, Illinois, has opened a new pool with its No. 1 Maude Rudy, Section 4-0-23, Henderson County. The well is producing from the Cypress sand at 2246-51 ft.

▼ **LOUISIANA.** Pure Oil Company No. 1 General American Transportation in the Good Hope area, near the Mississippi River in St. Charles Parish, has been completed in sand at 7830 ft. Initial gauge showed approximately 150 bbl. of oil per day.

▼ **CALIFORNIA.** The British American Oil Producing Company has opened a new oil pool in Kern County, California, with its No. 1-57 Portales, in 3-30s-29e, a mile east of the town of Edison. On a drillstem test at 4715-4768 ft., the well showed gas in 6 minutes, oil in 13 minutes, and flowed at the estimated rate of 400 bbl. of oil a day.



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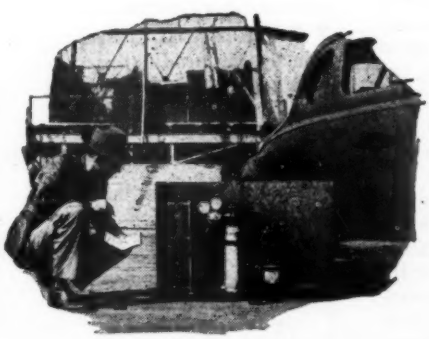

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MAJOR *Pipe Line* ACTIVITIES

▼ **INDUSTRY'S STAKE.** Ninety-two and a half million dollars of a total $259,500,000 have been expended by private industry in the government's oil pipe-line construction and conversion program. A total of 12,381 miles of pipe line is included in the new construction reversals and conversions as originally mapped. Eleven thousand, seven hundred, and three miles of this had been completed August 1. This construction program includes the Big Inch crude oil line from Longview, Texas, to New York and Philadelphia, and the Big Inch refined products line from the Texas coast to the New York harbor area.

▼ **COMPLETIONS.** Completion of a 10-mile, 4 and 6-in. carrier, connecting wells in the Carthage area with the trunk line of the United Gas Pipe Line Company, has been announced by Feazel and Kinsey of Shreveport, Louisiana.

Completion is due of a new 5.5-mile, 6-in. pipe line loop between the Fullerton field in Northwest Andrews County and the Magnolia Pipe Line Company's Andrews station. Magnolia will be able to haul 21,000 bbl. of oil each day from the field when the line is complete.

Pan-American Pipe Line Company has announced completion of its 36-mile, 8-in. crude oil line from the Willmar field of Southwest Texas to Port Isabel, at the mouth of the Rio Grande, on August 7.

The Texas Pipe Line Company's 34-mile, 6-in. products pipe line from Rockport, Illinois, to East Chicago, Indiana, has started operations.

The 16-in. and 8-in. crude oil lines from the Elk Basin, Wyoming, field, 8 miles to Laurel and Billings, Montana, refineries are now nearing completion.

Six-inch pipe was shipped this month from 10 mills to Barkhart, Texas, to begin construction of a 17-mile, welded line to the Ozona pumping station. The line will be laid by the Texas-New Mexico Pipe Line Company. There will be 13 miles of 4-in. gathering lines. Until completion of the line, oil will continue to be transported by trucks.

▼ **"BIG INCH" RECORD.** A total of 96,292,000 bbl. of crude oil has been delivered by the "Big Inch" line, which began its second year in operation recently. It is the world's biggest oil pipe line stretching 1363 miles from Longview, Texas, to the New York-Philadelphia area, and during the first year did the work of 23,000 tank cars operating on an 18-day turnaround schedule, Harold L. Ickes, Petroleum Administrator, announced.

Construction of the line started August 3, 1942, at Little Rock, Arkansas, and the first oil was pumped into the line December 31, 1942, at Longview. Norris City, Illinois, received its first crude oil from the line on February 13, 1943; and oil arrived at Phoenixville Junction and at refineries in the Philadelphia area on August 14, 1943. From Longview to Phoenixville Junction, Pennsylvania, 24 pump stations speed crude oil through 1254 miles of seamless 24-in. pipe. At Phoenixville Junction the pipe divides into 2 20-in. branches, one to Linden, New Jersey, and the other to Philadelphia.

"The delivery of Texas crude oil through the line to eastern refineries has prevented what could easily have developed into a catastrophic oil shortage along the Atlantic seaboard," Ickes said.

▼ **ASKS PERMIT.** The Tennessee Natural Gas Lines, Inc., Chattanooga, Tennessee, is seeking a certificate of public convenience and necessity to construct and operate pipe lines from southwest Texas to Nashville, Tennessee, and other unserved areas in central and eastern Tennessee. Application for permission to build these lines was filed with the Federal Power Commission early this month.

The gas will be supplied by the Tennessee Gas and Transmission Company, which is constructing a 24-in. natural gas pipe line from Texas to coal-producing areas.

The proposed line will deliver an average of 3,000,000 cu. ft. of gas per day at the city gate of Nashville to the Nashville Gas and Heating Company, now distributing manufactured gas in the city and environs. It is the plan of the applicant to construct facilities to make natural gas available to other unserved areas in the state of Tennessee, including Chattanooga and Knoxville, as soon as materials become available for the purpose.

▼ **TRANSPORTATION RECORD.** An all-time high for movement of crude and refined petroleum by pipe line to the East Coast was reported for the week ending August 5. Deliveries for the week averaged 715,222 bbl. per day against a previous record of 709,075 bbl. daily set in the week of July 15. Record movement consisted of 438,286 bbl. of crude oil and 276,936 bbl. of refined products.

▼ **PLAN NEW FACILITIES.** S. B. Irelan, president of the Cities Service Gas Company, has announced plans for construction of $1,500,000 worth of new pipe line facilities in Oklahoma and Kansas. Application has already been made to the Federal Power Commission for authority to build the lines, Irelan said. He estimated the lines would add 32,000,000 cu. ft. of gas daily to the capacity of the eastern section of the company's system.

The proposed expansion includes:

Fifty-two miles of 16-in. gas pipe line from Shidler, Oklahoma, to Caney, Kansas, to carry fuel from the Hugoton field.

Six and one-half miles of 16-in. line in Wilson County, Kansas, connecting two existing transmission lines.

Improvement program at the company's Graham compressor station in Allen County, Kansas.

"This additional gas will furnish ample supplies to meet all domestic demands on the company's east side this winter," Irelan said. "It will also reduce curtailments of industrial gas to a minimum and will enable the company better to utilize its large underground storage facilities in the former gas fields near Welda and Craig, Kansas, with capacities of 27,000,000,000 ft.," he added.

▼ **BEGIN LINE.** Construction on a new 110-mile, 6-in. pipe line from the Iles Dome and Wilson Creek pools of western Colorado to tie into its main Wyoming-Salt Lake City line, will be begun soon by The Stanolind Pipe Line Company.

▼ **OPPOSES LINE.** Louisiana opposes the Memphis Natural Gas Company's doubling its pipe lines from Monroe because the state needs to preserve its natural gas reserves.

"Louisiana has no form of mineral fuel other than oil and gas," said Col. P. A. Frye of Baton Rouge testifying at a Federal Power Commission rehearing of the company's previously denied request.

Alden T. Sherrill, in upholding the position of the gas company, said present facilities of the firm are not adequate to permit service to users at times of extraordinary weather conditions.

▼ **TANK TRAILERS.** Final authorization for the production of 972 petroleum tank trailers has been reported by WPB.

Tank cars service East

Approximately 115 carloads, representing two full trains, of crude oil are being transported to the East Coast by railroad each day from the Midland, Texas, loading rack of Atlantic Pipe Line Company. No oil is being sent from Midland to the Pacific Coast refineries, which are not equipped to handle the sulphur oil from the Midland region efficiently.

Big line nears completion

Completion of the Tennessee Gas and Transmission Company's 24-in. natural gas pipe line from Corpus Christi, Texas, to West Virginia has been scheduled for October 1. By October 15 the conduit will be feeding 287,000,000 cu. ft. of gas daily to the Appalachian area, President Gardiner Symonds said. Construction of this line was begun first of this year.

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DIESEL ENGINES

MAJOR *Refining* ACTIVITIES

▼ **HYDROGENATION UNIT.** For the production of 100-octane aviation gasoline, a hydrogenation unit, the last of several to be completed in the Baytown high octane program, was put into service recently by the Humble Oil and Refining Company. For a number of years Humble has transported a product known as copolymer to other refiners for final processing. The new unit makes it possible, with the addition of hydrogen to copolymer to manufacture a useful component for 100-octane gasoline at the Baytown plant.

Recently catalytic cracking fractions, base stock for aviation gasoline when hydrogenated, have also been shipped by Humble to other refining plants. Addition of the new unit also eliminates the need for this transfer, and other refiners in the area will not send catalytic stocks to Baytown for hydrogenation. The new unit is a defense plant corporation project and will be operated by Humble for the Defense Supplies Corporation.

▼ **VENEZUELA REFINERY.** Initial survey in Venezuela for the location of a 35,000-bbl. refinery was begun recently by the Sinclair Refining Company. George H. Tabor, vice president in charge of refining operations for Humble, has gone to Venezuela with a group of technicians, to start construction of the plant. Crude oil for the refinery will be moved by pipe line from the Santa Barbara field.

▼ **TEST NEW CATALYST.** Testing of the "magic bead" catalyst in the manufacture of high octane gasoline for Allied air forces, was begun recently by the Socony-Vacuum Oil Company, Inc. Wilbur F. Burt, director and chairman of the manufacturing committee, said this is the last on Socony-Vacuum's war building program, and would turn out thousands of barrels of aviation gasoline daily with a rating of 100-octane-plus.

▼ **WANT 80-OCTANE.** PAW has sent telegrams to all major oil refining companies asking an increase in the output of 80-octane all-purpose gasoline to meet urgent demands of the armed forces to maintain the advances in Italy and the Pacific theater. Need for 80-octane gasoline is as urgent as the need for 100-octane aviation fuel, the telegrams said, and manufacture of 80-octane gasoline must be increased to as great a degree as possible without interfering with the output of 100-octane gasoline.

▼ **SUPER-FUEL.** Mass refining of super octane gasoline will go into production at Texas refineries as soon as the plants can make necessary changes following the expected request from the government to go ahead, the Texas Mid-Continent Oil and Gas Association has announced. Planes using the new fuel can take off quicker, fly faster and longer, officials said. The formula for this super-fuel and the changes in the refinery processes necessary to make it are closely guarded secrets.

▼ **FIRE.** The new Sun Oil Company high-octane gasoline refinery was wrecked by flames which spread through an underground piping system on August 14. Rawleigh Heacock, chief marshal of the Sun Oil Company's fire department, and employees saved much of the plant by shutting off the valves. The explosion was caused when some liquid butane gas was being drawn from one of the spheroid containers into the compressing system. Plant officials said they could not estimate the damage, but the compressed apparatus was virtually wrecked. The plant was the scene of another explosion on March 13, which took four lives.

▼ **SMALL REFINERIES.** Fluid flow catalytic cracking units are now available and are proved efficient for the small refiner, Universal Oil Products Company has announced. One of its units, with a capacity of 2000 bbl. a day, is in successful operation at the new plant of Frontier Refining Company at Cheyenne, Wyoming, the company said. Company engineers have designed fluid flow catalytic cracking units of 1500 to 1600-bbl. a day capacity, the announcement said.

▼ **REFINERS' QUOTA CUT.** PAW sent directives to 14 refiners requiring them to share with 16 other refiners in the Middle West District a total of 21,795 bbl. of crude oil daily in September, under the wartime crude allocation plan. This is the smallest volume of crude involved in any month's operation in the crude sharing program thus far. Last month 21 refiners were directed to supply 21 other refiners 28,620 bbl. of oil daily under this program.

Cracking plant planned

The modified area production committee, the Houston district of WBP, has recommended for approval the application of Shell Oil Company, Inc., to construct a $10,800,000 catalyst cracking plant in Deer Creek, site of the company refinery. The action by the committee means approval at the district level, and probable favorable reaction from WPB in Washington.

The committee in investigating the application, presented to it by R. V. Shirk, official of PAW, found that there is sufficient labor supply in the district to construct and operate the plant. Between 700 and 1000 workers will be needed for construction work, it was stated.

P. E. Foster, manager of the Shell Refinery, said that the original application was filed more than a year ago, and that the latest application was sent in about a month ago.

▼ **GASOLINE OFF 32%.** The petroleum supply for civilians has suffered a 32 per cent slump in the last 3 years according to recent figures released by PAW. Refineries and natural gasoline plants in the United States produced a daily average of 1,237,700 bbl. of civilian grade motor gasoline during the period July 1 through August 5. This represents a decrease of 31,400 bbl. compared to the daily average of 1,269,100 bbl. reported for the first 6 months of 1944.

Less civilian gasoline is manufactured because more and more of the crude oil is refined into 100-octane gasoline and other military products. The result is a reduced yield of civilian grade gasoline per barrel of crude oil. This reduction in refinery yields of civilian gasoline took place despite the fact that average daily crude oil runs to stills during the last 5 weeks were 183,000 bbl. higher than the daily average the first half of 1944.

▼ **PLANT TO EXPAND.** Plans have been completed by General Petroleum Corporation for construction of a $4,000,000 addition to its Torrance, California, refinery for the production of 100-octane aviation gasoline.

The expansion is designed in part to alleviate possible unemployment in the area due to partial demobilization. The plant will be built by the M. W. Kellogg Company and 700 to 800 men will be employed.

New facilities will have a capacity of from 13,000 to 15,000 bbl. of components each day, according to company spokesmen.

▼ **ENTER THE KNOCK.** Shortages of tetraethyl lead are largely responsible for the knock which has returned to plague motorists after being curbed by chemists for two decades. A program of care and maintenance of the automobile can greatly reduce the knock, however, according to findings of Ethyl Corporation engineers. Motorists are warned to start slowly, get up speed approaching a hill, and shift gears on hills. In severe knocking, a check-up should be made of combustion chambers, spark plugs, distributor, timing lines to carburetor, radiator flushing and water jacket conditions, fan belt, thermostat, water pump, and other parts requiring servicing.

Quality of civilian gasoline will remain low until military demands are supplied, Ethyl engineers, emphasized.

THE Petroleum Engineer

SEPTEMBER, 1944

WEST EDMOND—CENTER OF OKLAHOMA ACTIVITY

By FRANK B. TAYLOR, *Engineering and Sales Company, Tulsa, Oklahoma*

EXCLUSIVE THE West Edmond field, Oklahoma County, Oklahoma, a 1943 discovery, is currently the most active development of the Mid-Continent area with more than 100 wells drilling. Other areas, combining a number of individual pools, are larger but West Edmond enjoys the distinction of setting a new pace in drilling and concentrated development of a single major reserve.

The productive area now encloses some 18,000 acres considered proved, and an additional 6000 acres apparently proved. The reserve is defined toward the southwest, and by dry hole control to the east. Opinions differ vastly concerning the potential limits of the field, some investigators placing the northern limit 6 miles north of most northernly production and almost an equal distance south of the field's present limit in this direction. Total production has passed the 3,250,000-bbl. mark and in late August the field was making 21,000 bbl. daily from 115 wells. Careful check is being made on pressure trends within the reservoir as it is produced. This work of the Corporation Commission is being directed by Walker T. Pound with Tom Bailey running the field test unit and supervising bottom-hole pressure bomb tests. The producing formation is the Bois D'Arc section of the Hunton lime at a subsea level of 5800 ft. in the heart of the field. The Bartlesville sand in the Pennsylvania series also provides minor production in 3 wells.

▼ **Discovery.** The West Edmond field afforded a major discovery surprise. There was no geological recommendation for the discovery location and no evidence to support the presence of a large reserve. Ace Gutowsky, independent operator of Oklahoma City "doodlebugged" the area and spudded his well January 2, 1943. The location was Wagoner 1, NW NW SW 32-14n-4w. The main objective of the test well was the second Wilcox (Ordovician) sand, which was cored from 7648 to 7690 ft. and showed water. The well was backed up to the Hunton lime at a depth of 6877-7220 ft., where good showings had been found, and was washed in with treatments of 1000 and 2000 gal. of acid. The discovery well was completed March 24, 1943, and on a 12-hr. test made 365 bbl. by heads. Elevation at the derrick floor was checked at 1106 ft.

With more than 100 wells drilling, this area is currently the most active development in Mid-Continent area.

▼ **Geology.** The discovery of West Edmond supports the view frequently expressed by geologists that major fields of the stratigraphic type are yet to be discovered, for subsequent development proved this reserve to be of that nature.

The reserve is located upon the west flank of the regional rise to the Nemaha Ridge, west of the major Wilcox sand trend that produces at Oklahoma City, Edmond, Crescent, and other places with anticlinal features to the north and south that are supported by the Ridge. Strata dip to the west into the Anadarko Basin at a rate of slightly more than 100 ft. to the mile through the field with some irregularity at the top of the Devonian due to the erosional surface nature of this section.

Accumulation in the Bois D'Arc is evidently controlled by pinching out of this stratum to the east of development, whereas the reserve within the Bartlesville sand is controlled by its lensing nature. The latter has been found in the southwest part of the field and to the east, but is not of wide or dependable distribution in those areas now developed. The apparent lack of structural features makes improbable the finding of Ordovician production. A fault appears indicated northwest to southwest from near the center of 26-14-5w through the northwest of 35-14-4w, south of a stream-produced depression in the Bois D'Arc that has resulted in a curved line of dry holes.

The extent of this stratigraphic trend is entirely problematical. Certain anticlinal conditions in the general area have been found and some of these are being tested at present. Findings will provided much needed control for further exploration along the new trend.

Although there are no commercial completions in the Oswego lime or in the Mississippian lime in the West Edmond field to date, both formations have shown varied degrees of saturation in a number of wells. Porosity in the latter formation increases toward the north end of development and lends encouragement to the possibility of finding production in this section; or this characteristic may mean only an additional circulation hazard in drilling operations.

▼ **Drilling.** West Edmond is a 100 per cent rotary drilled field. Depth of 7000 ft. from the surface demands substantial rotary equipment, and the further demand for fast time requires good drilling technique. Some portions of holes are "tough digging" and those that are not are often apt to be the cause of trouble because of caving tend-

encies. Additional rigs could be used in the area to advantage if they were available. Drilling programs are being retarded by lack of equipment.

Three slim-hole units are operating successfully, although the regular rig is standard with a 122-ft. derrick, internal-combustion engines compounded, and complete accessories. A number of steam rigs are in operation despite a local scarcity of good water. This handicap is being alleviated by the development of subsurface sources and the construction of water systems within the field. Additional water is being provided from the older Edmond producing area 6 miles to the east. Virtually all surface sources of water have been tapped, and these are high in sulphates.

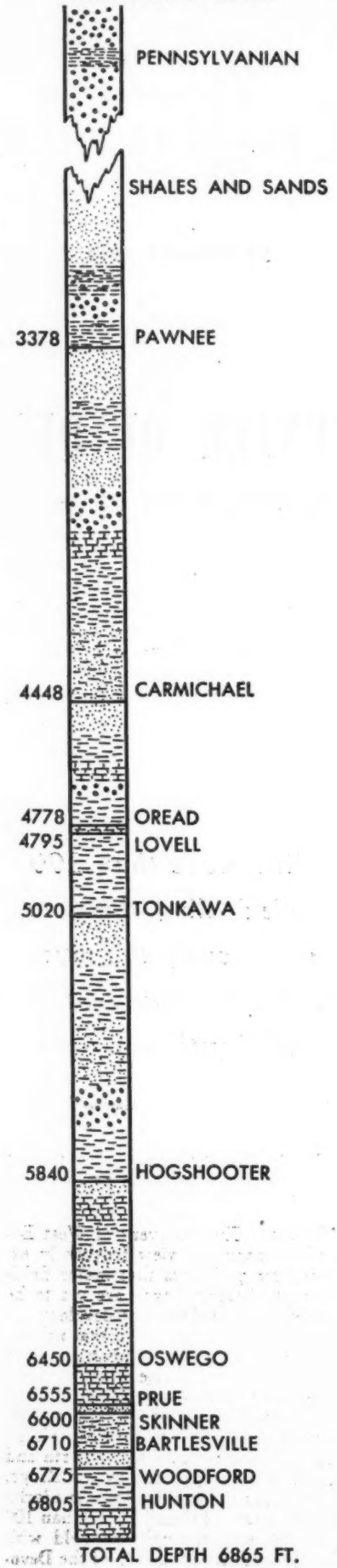
Drilling time has been shortened from 75 days to a present average that approaches 60. Per foot cost is approximately $7. One of the early drawbacks was a lack of experienced crew men and although this condition still exists to a limited extent it is no longer critical.

Surface pipe, 10¾ in., is run through surface sediments and water strata to 350-500 ft. From this casing point to total depth is open hole drilling, no intermediate string being required. After running surface pipe, drilling is through alternating shales and sands, some of which are difficult to penetrate, to a point above the Oswego lime where small boulders and a caving condition frequently cause trouble. The Oswego lime is slightly less than 100 ft. thick, only relatively hard, and is fairly uniform throughout the field. The caving shale above the Oswego lime is not a particularly serious problem during drilling, but after the hole has gone into harder formation beneath the shale there is a tendency for the caving to continue and for loosened material to drop on the tools. In the smaller hole being drilled through the harder formations, this has resulted in fishing jobs due to sticking of the tools. At times, boulders have been brought to the surface when making a run. A somewhat similar condition exists below the Checkerboard lime.

Although this caving condition has been compared with Gulf Coast heaving shale, it is by no means as bad, nor does it uniformly flow into the hole. Instead, it apparently continues to slough off, and seems to be more or less severe in proportion to the weight carried on the bit while drilling through. Tons of the broken shale are dumped into mud pits.

There have been a considerable number of fishing jobs in the field although in most instances they are performed in a short time. In addition to the problem of sloughing shales, another type of fish is encountered in upper sections of the Pennsylvania shales and sands. In this case the tools are usually near the Hun-

Geological section of well, location NW 20-14-4w.



Contractors now drilling the 100 tests and more in the West Edmond field come not only from Oklahoma but also from Texas, Kansas, Arkansas, Louisiana, Montana, Michigan, Illinois, Indiana, and Colorado. Only a few operators are using company tools, most of the drilling being under contract.

Kerlyn Oil Company is most active operator with 14 units drilling. Champlin Refining and J. E. Trigg each has 5; Big Chief Drilling and Warren-Bradshaw each has 4; Viersen-Cochran and Denver Producing and Refining each has 3 rigs drilling.

Two each are being run by Johnson and Flesher, M-B-K Drilling, J. E. Mabee, Olson Drilling, Summit Drilling, Taber and Coleman, Ace Gutowsky, Hugh Pearce, Magnolia Petroleum, Arrow Drilling, H. H. Wegener and Harbar Drilling.

Others having one rig each include: Noble Drilling, Burr Lambert, Clark Drilling, D. and J. Drilling, C. E. Davis, Fain-Porter Drilling, Franklin Drilling, Great States Oil, Hissom Drilling, Lee Drilling, Mohawk Drilling, Fred Morgan, Parker Drilling, Ptak Drilling, Phillips Petroleum, Williams and Copeland, Apex Drilling, F. C. Hall, Earl Wakefield, Nelson Drilling, Daniels Drilling, Lynn Drilling, Hugh Hodges, Delaney Drilling, Hall and Briscoe, Blackstock-Rowland, T. J. Carter, O'Rourke and Baker, Olsen-Blount, Smith and Horton, Smith Brothers, Schoenfeld, Hunter and Kitch, Stephens Petroleum, George T. Livermore, Creekmore Drilling, Wilcox Oil and Gas, Barnsdall Oil, Byars Drilling, and Iron Drilling.

Contractors scheduled to move in units when they are available include Jennings Drilling, Jack Grace and D. C. Norwood, all of Wichita Falls; Falcon-Seaboard of Tulsa, Beacon Drilling of Tulsa, and Lupher Drilling of Reed City, Michigan.

It was indicated that bottom hole pressure of the West Edmond field was not being greatly lowered by the apparent over-production of many of the Hunton lime wells there. A BHP survey made by Walter T. Pound, conservation officer of the Oklahoma Corporation Commission showed that the average pressure at minus 5864 ft. was 2080.26 lb., indicating a decline of but 100.41 lb. since the last check made in May.

The state inspectors reported that 14 comparable wells revealed a decline of 86.57 lb. in 93 days, or less than one pound a day. Thus the pressure decline was computed at 1 lb. per 16.848 bbl. of withdrawal. This is being supported by keeping daily output at 200 bbl. a day.

Accumulated production of the West Edmond field to August 20 was 3,208,000 bbl.

A survey in midweek the last of August showed the following statistics:

50 locations, named and numbered.
95 tests rigging up or drilling.
13 tests waiting on the last string, or testing.
124 Hunton lime producers.
2 Bartlesville sand wells.
9 dry holes.

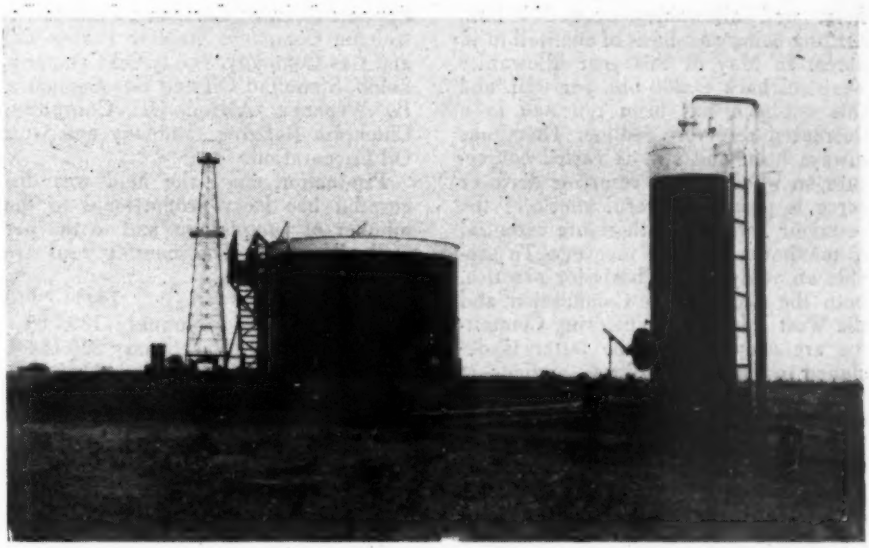
The above totaled 323, and did not include 5 outside tests, still called wildcats. It showed exactly 103 rotaries busy, a large per cent of the 1650 rotaries that were operating in the oil country.

ton lime, and the fish occurs while they are being run out of the hole. The drill pipe apparently cuts into the wall of the hole at about 1800-2200 ft. to produce a "key-way," while rotating the bit at below 6000 ft., and in attempting to withdraw the bit through this narrowed slot it lodges to stick the pipe at the shallow depth.

The number of rock bits varies usually between 38 and 42, the greatest wear occurring below the Oswego lime, or in the last 400 ft. of hole. Average footage per bit is 190, with actual drilling-in time per bit only a little less than 24 hr. In all but a few wells 9-in. bits are used.

▼ **Drilling mud.** Control of the well by mud circulation is an essential feature of drilling. This is due chiefly to the caving conditions of upper strata, and the necessity of keeping the upper hole in condition even when the tools are approaching total depth. A few operators condition their initial mud with Bentonite, but most operations begin complete treatment at or near the top of the Cherokee at about 4700 ft. As no high pressures are encountered, no weighting materials are necessary, and treatment consists primarily of viscosity control with caustic and chemical treatment in a few instances. Water loss is held to plus or minus 15 cc. to 6000 ft. and about 12 cc. to total depth, with some wells showing losses considerably in excess of these figures due to stratigraphic variations.

Between 25 and 35 tons of jel-producing materials are used per well. With the start of the mud into the well, the makeup is usually treated with soda ash to combat calcium sulphates carried in the water. As water is added later, a lesser treatment may be resorted to. Viscosity to 6000 ft. is approximately 38 sec. (Marsh Funnel) and below this depth is 40-42 sec., and the mud weight 9.8 to 10 lb. Many operators are doing their own mud testing and control.



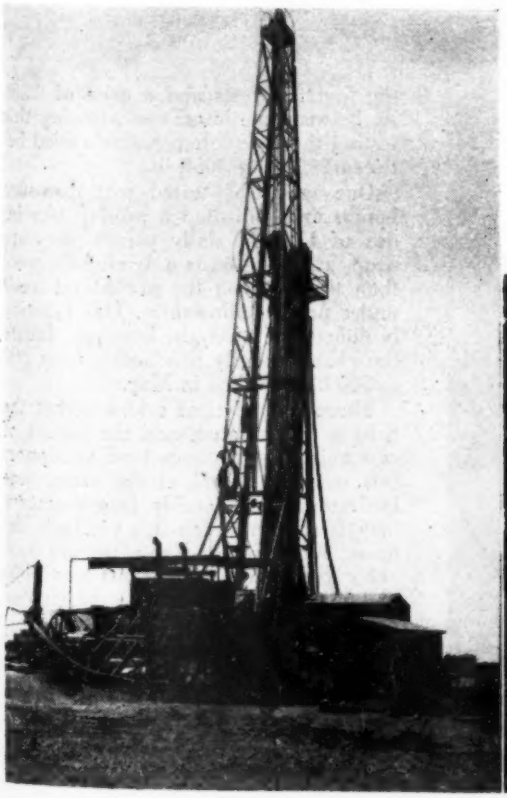
One type of lease setup in West Edmond as installed on the Cypher lease in 17-14-4w. A single separator is required, few wells making water. Well in background is rigging up.

▼ **Completion.** Completion practice generally is to set a 7-in. oil string through the Bois D'Arc section of the Hunton line, a thickness of 95 ft. or less, and perforate. The mud is replaced with water, then with oil, and the well is washed in. Small volumes of acid are used in many wells to clean up the pay section where drilled. All wells are electrically logged to study the producing horizon characteristics as well as to correlate upper formations.

Wells are put on production through 6/64-in. and 7/64-in. surface chokes, most of which are adjustable although one operator is using a positive control. A single separator is sufficient to handle all production. The original bottom hole pressure was 3110 lb. Lease tank capacity is from 500 to 1000 bbl., gravity of the crude being 41 deg. API and above. Gas produced with the oil is utilized as fuel in the field, by commercial carriers with connections to the field, and in gasoline plants.

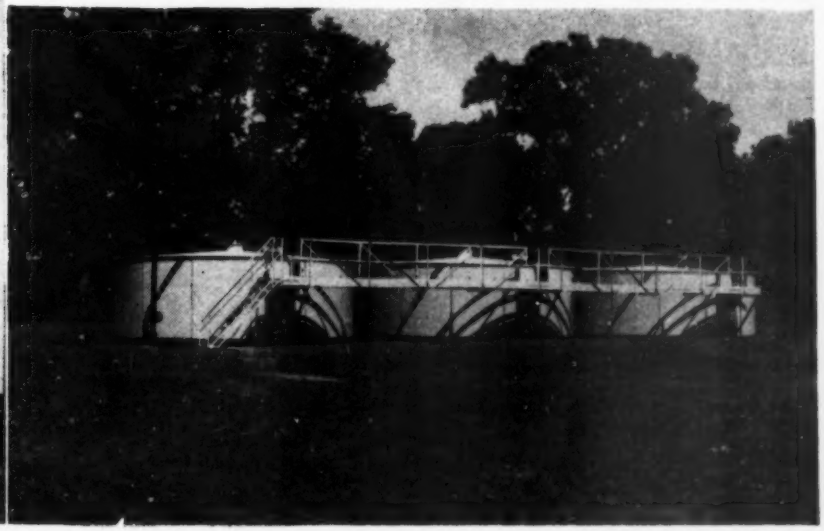
Peppers Gasoline Company has a 10,000,000 cu. ft. capacity gasoline extraction plant under construction in section 33-14-4w, with part of the gas gathering system already underground. This plant will handle the increasing volumes of gas as the field is developed and is expected to recover 1-plus gal. per 1000 cu. ft. as indicated by test run.

▼ **Production and control.** In the early stages of development of West Edmond



Three slim-hole units are active in West Edmond and have turned in exceptional drilling speeds.

West Edmond lease installation using 3 250-bbl. tanks in conventional manner.



field, well allowables were 300 bbl., drilling being on a basis of one well to 40 acres. In May of this year allowables were cut back to 200 bbl. per well, and this cut-back has been reflected in a decreased reservoir decline. There has always been and still is varied conjecture on what type of reservoir drive or force is present. Careful check of the reservoir behavior is therefore essential to maximum ultimate recovery. To provide an analysis as a basis for practice, both the Corporation Commission and the West Edmond Engineering Committee are cooperating. The latter is designed to obtain, coordinate, and report factual data pertaining to efficient operation of the field and represents 75 to 80 per cent of the operators, with additional firms having indicated their intention of joining the group. Glenn M. Stearns, formerly associate professor of petroleum engineering at Oklahoma University, is chairman of the advisory committee of the member firms.

Those who are now active participants include:

Amerada Petroleum Corporation, Anderson-Prichard Oil Corporation, D. D. Bourland, Chudacoff, Continental Oil Company, Denver Producers and Refiners Company, Dickey Oil Company, Fox and Fox, H. J. Schmitz, Magnolia Petroleum Company, C. L. McMahon, Mid-Continent Petroleum Corporation, Peppers Refining Company, Phillips Petroleum Company, Sinclair Prairie Oil and Gas Company, Skelly Oil Company, Sohio, Stanolind Oil and Gas Company, H. Wegener, Allied Oil Company, Champlin Refining Company and Gulf Oil Corporation.

Production since the field was discovered has been proportional to the number of completions and to the per well allowables. The monthly runs are as follows:

1943	1944
May 11,727	January 189,216
June 12,093	February 236,134
July 17,633	March 310,249
August 41,935	April 395,680
September 48,916	May 332,099
October 62,597	June 380,300
November 117,795	July 464,000*
December 147,401	August 581,000*

*Estimated

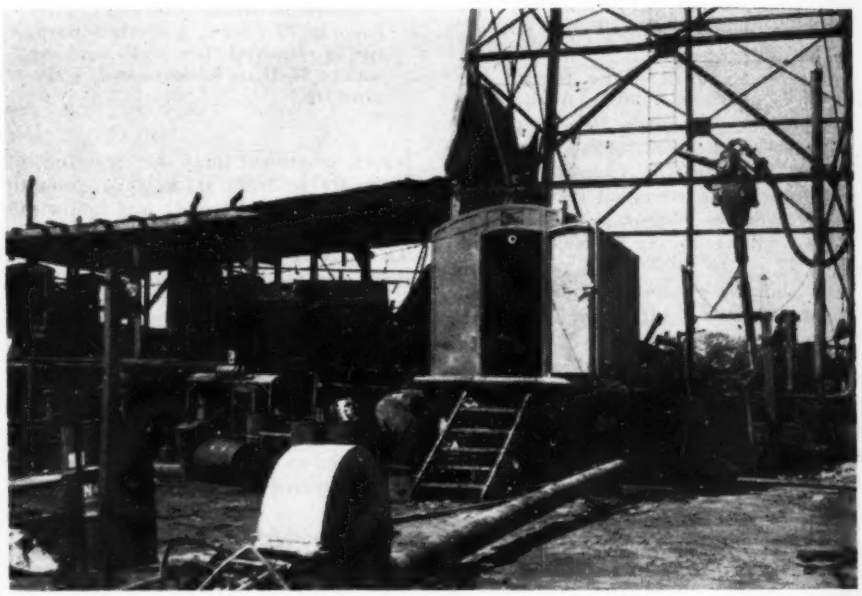
The last pressure check by the Corporation Commission was completed in late August and provided the following interesting information. Up to March 15, 1944, the field had produced 1,500,000 bbl. at which time 16 wells showed a pressure of 2969 lb. at the formation. At the time of the May 17 pressure check, 30 wells showed an average pressure of 2901 lb., and to this time the field had produced 1,750,000 bbl. The last month check of 32 wells with cumulative production at 3,100,000 bbl. showed an average reservoir pressure of 2827 lb.

Three wells, carried as controls, showed: (1) Denver's No. 2 Genzer, a drop of 1.466 lb. between the first and second tests and 0.0988 between the last two; (2) the same firm's No. 2 J. M. Young showed a 1.874-lb. drop between the first two tests and a 1.285-lb. drop between the last two; (3) Sohio's No. 1 Young showed a drop of 1.102 between the first two tests and a drop of 0.589 lb. between the latter tests. During this testing the reservoir pressure varied between 2028 and 3059 lb.

One well was tested with pressure bombs and indicated a productivity index of 152 bbl. daily per lb. pressure drop, a figure that is only slightly more than the drop on the per barrel basis under present allowables. This function is difficult of analysis, however, due to the changed daily production from 300 to 200 bbl. applied in May.

There is analytical evidence that the field is unsaturated, and the results of reservoir pressure tests tend to support this contention and at the same time indicate a considerably larger reserve may be present than has yet been defined. West Edmond reserves are anyone's guess, and may be between 5000 and 15,000 bbl. per acre in the Hunton lime.

Regardless of ultimate size, the field represents the highlight of exploratory activity in Oklahoma during recent years and is currently the most active single development in the Mid-Continent area. ★ ★ ★



Two, three, or four internal-combustion multi-cylinder engines, using gas as fuel, power the majority of rigs. Some steam units are in service. Complete accessory equipment is necessary.

Well hookup as shown readily handles the 200 bbl. daily allowable through either an adjustable or fixed choke. All production is flowing with reservoir pressure about 3000 lb.

HEAT PROVIDES FOR EFFICIENT HANDLING OF SIX GRAVITY OIL

By CLAUDE L. COLE, Exeter Oil Company, Ltd.
Manager of Production and Drilling

EXCLUSIVE THE production, storage, and transportation of heavy oil having a gravity of 6.5° API present problems not encountered with oils that flow at normal temperatures. This heavy oil is in particular demand at the present time for the manufacture of asphalt to be used in construction of air fields and military roads as well as for civilian purposes.

In order to facilitate the handling of an oil that is unpumpable at atmospheric temperatures, the Exeter Oil Company, Ltd., has installed equipment that produces the oil from its well Lenox No. 2 at Oxnard, California, at high temperature and maintains it at elevated temperatures until it is delivered to its refinery in Long Beach. The method employed is not only more economical than the customary methods used for the production and handling of oil of this character but also provides for the delivery of a better raw product for refining.

Other wells in the Oxnard area are produced by the injection of gas oil into the well and then pumping this mixture to the surface. From 10 to 12 per cent of gas oil is used in this procedure and the actual gravity of the heavy oil being produced is not known. After the mixed oil is brought to the surface it is heated for shipping to a temperature of approximately 175°F. It has been found that if the mixed oil is heated above this temperature it will foam.

No thinning agent of any kind is used with the oil being produced by the Exeter well. The production is kept in a condition for ready handling by the oil well pump by the circulation of hot water. Present production of the well is 380 bbl. per day with less than 1 per cent of water.

Total depth of the well is 2812 ft., a string of 13⅜-in. surface casing being cemented at 160 ft. and a string of 8⅝-in. at 2480 ft. A 7-in. slotted liner (16 rows, 187 mesh, 6-in. centers) is supported by a lead seal liner hanger with its top at 2472 ft.

The down-hole equipment used for circulating hot water in the well is shown in Fig. 1. A string of 6⅝-in. casing was run inside the 8⅝-in. string and set just above the top of the liner with a lead seal packer. The packer was placed at the bottom of the string and above it was inserted a 6½-in. cylindrical billet that had been milled out with beveled top to a hole of the same inside diameter as 3-in. tubing, as shown in the drawing. This billet was made with male thread on bottom and female thread at the top. There were 8 slots made in the 6⅝-in. casing above the billet, these slots being 2 in. long, 0.5 in. wide, and spaced 6 in. apart. A string of 3-in. tubing with lead-faced bevel on bottom was then run to a seat on the top bevel of the billet.

Hot water is circulated continuously downward between the tubing and the 6⅝-in. casing, through the slots in this casing, and up between the 6⅝-in. and 8⅝-in. strings. The water is injected at a temperature of 265°F. and has been found to be consistently at 235°F. upon its return to the surface. This circulation heats the oil in the well and by thus keeping its viscosity down provides for easy pumping of the well. The temperature of the oil at the surface is the same as that of the water, 235°F.

The water is circulated by a centrifugal pump at a rate of 130 gal. per min. The suction line of the pump is 3-in. and a pressure of 10 lb. per sq. in. is carried on the suction intake. The water is dis-

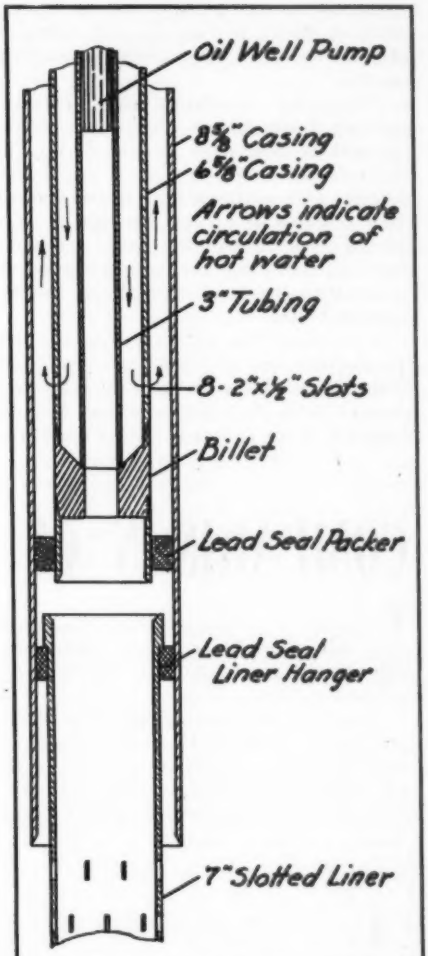
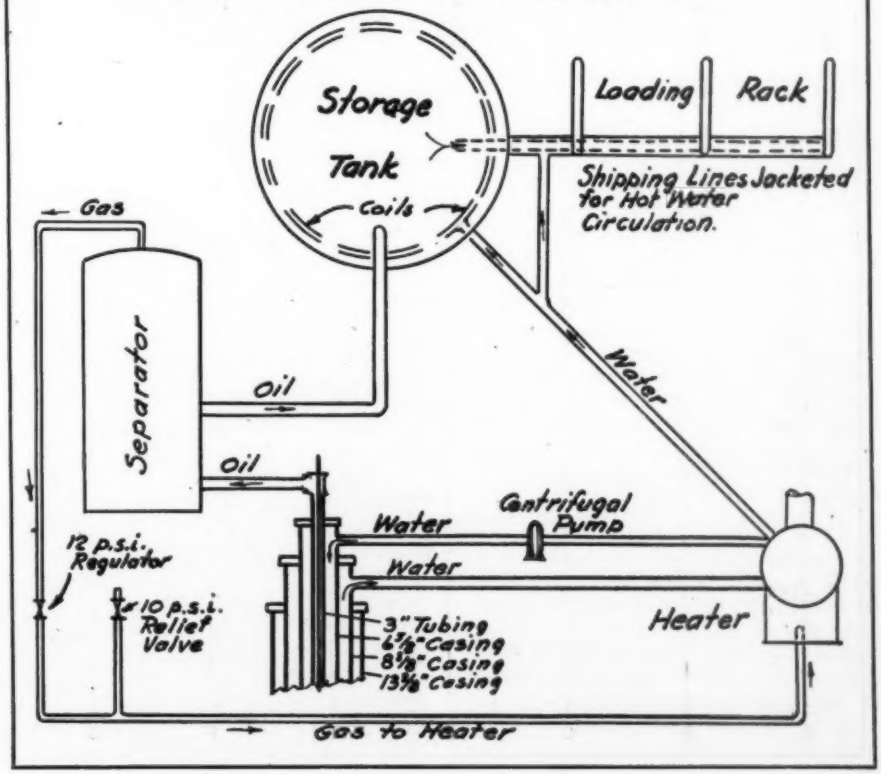


Fig. 1. Down hole equipment used for circulating hot water in well.

Fig. 2. General surface layout for handling heavy oil.



(Editor's Note: The equipment here described was designed and the installation made by Mr. Cole.)

charged through a 2½-in. line at a pressure of 60 lb. per sq. in. The pump is driven by a 7½-hp., 50-cycle electric motor.

Water for circulation and for maintaining temperature of the oil aboveground is heated in an old 85-hp. oil field boiler converted to a hot water heater. This is larger than necessary but was put in this service because it happened to be available. Crude was first used for fuel but since the installation of a gas trap, gas is now employed for firing the boiler.

For a short time after the well went on production the gas was not separated from the oil. The gravity of the oil in the storage tank during this period ranged between 6.2° and 6.4° API. After installing a separator and taking off the gas, the gravity of the oil in storage increased to 6.8° API. This increase was due to keeping the condensates in the oil by removing the gas under a pressure of 12 lb. per sq. in. and thus not allowing the gas to pass off freely at atmospheric pressure and carry the condensates with it. The separator is equipped with heat coils but is otherwise a conventional separator with kidney-valve liquid level control.

Temperature of the oil in storage is maintained at approximately 215°F. by hot water coils placed within the tank and close to the perimeter. The hot water is, of course, supplied by the same heater that supplies hot water to the circulating system in the well. The oil is taken from the tank to the loading rack from a point 3 ft. distant from the wall of the tank in order to obtain oil of an average temperature.

The heavy oil is shipped by tank trucks, which are loaded at a loading rack. All shipping lines are jacketed for hot water circulation. The tank trucks are loaded with oil at a temperature of 215°F. and haul the heated oil a distance of 80 miles to the Long Beach refinery in approximately 3 hr. There is a heat loss of less than 30°F. during the trip so the oil is delivered in easily-handled condition. Due to unavoidable causes, one truck was once delayed for considerably more than half a day but the oil was still in such condition that the tank could be unloaded. ★★★

P 090.

COMPARISON OF OIL AND COAL VALUES

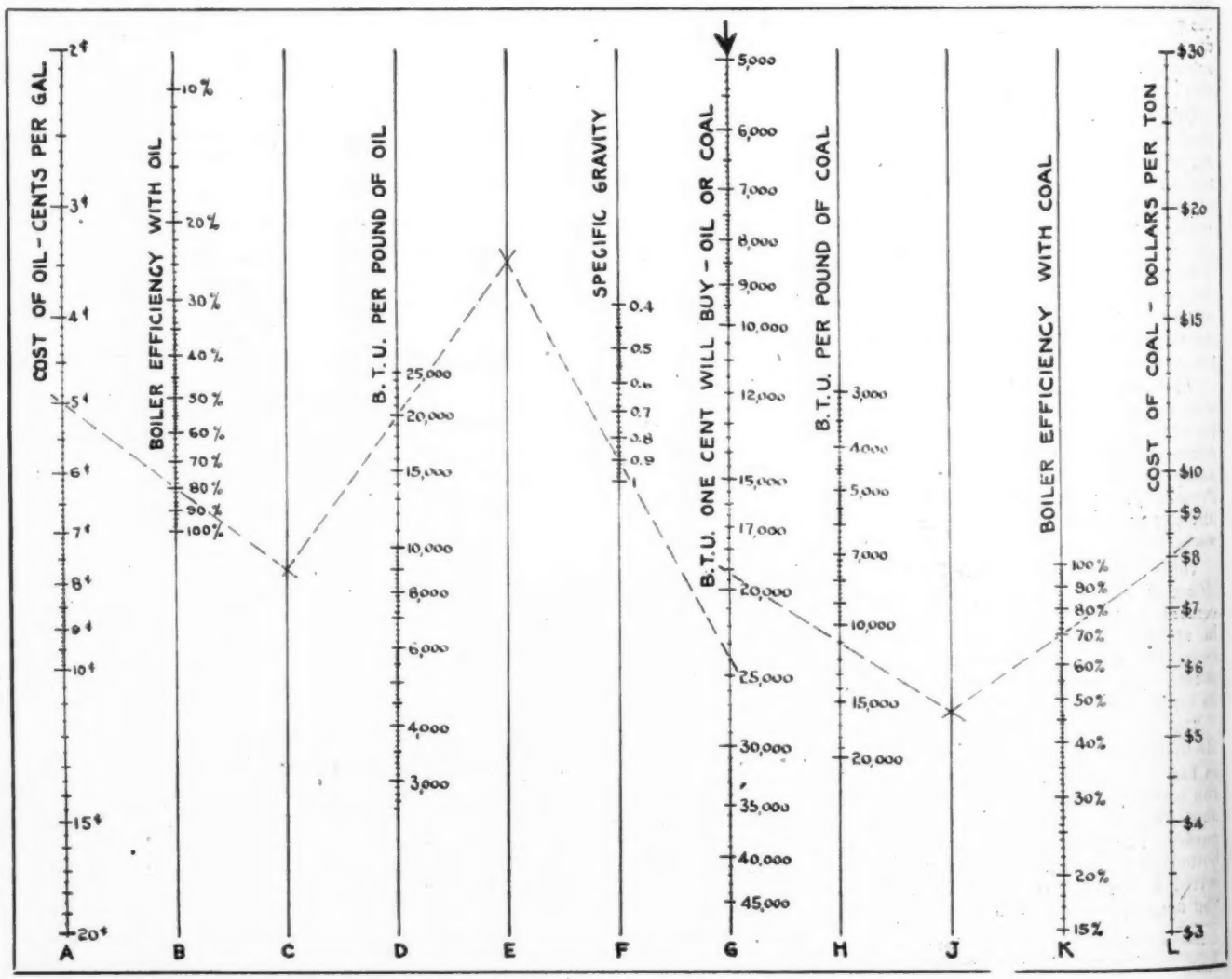
By W. F. SCHAPHORST

To assist in checking oil values against coal values, which is a very important subject, the accompanying chart was developed by the writer.

Simply zigzag through the cost of oil per gallon, column A; boiler efficiency with oil, column B; B.t.u. per pound of oil, column D; and the specific gravity, column F. The intersection with column G gives the number of B.t.u.'s in the oil that can be purchased for 1 cent.

Then zigzag from the right through the cost of coal, dollars per ton, column L; boiler efficiency with coal, column K; and B.t.u. per pound of coal, column H. The intersection with column G now gives the number of B.t.u.'s in the coal that can be purchased for 1 cent.

The dotted lines drawn across the chart show the comparison of oil at 5 cents per gal. with coal at $8 per ton. In this particular instance 1 cent will buy 24,000 B.t.u. of oil, or, a little over 19,000 B.t.u. of coal. Oil therefore has an important advantage under the conditions of this problem as outlined by about 5000 B.t.u. for 1 cent. ★★★



REPUBLIC'S NEW FACILITIES FOR AVIATION GASOLINE MANUFACTURE

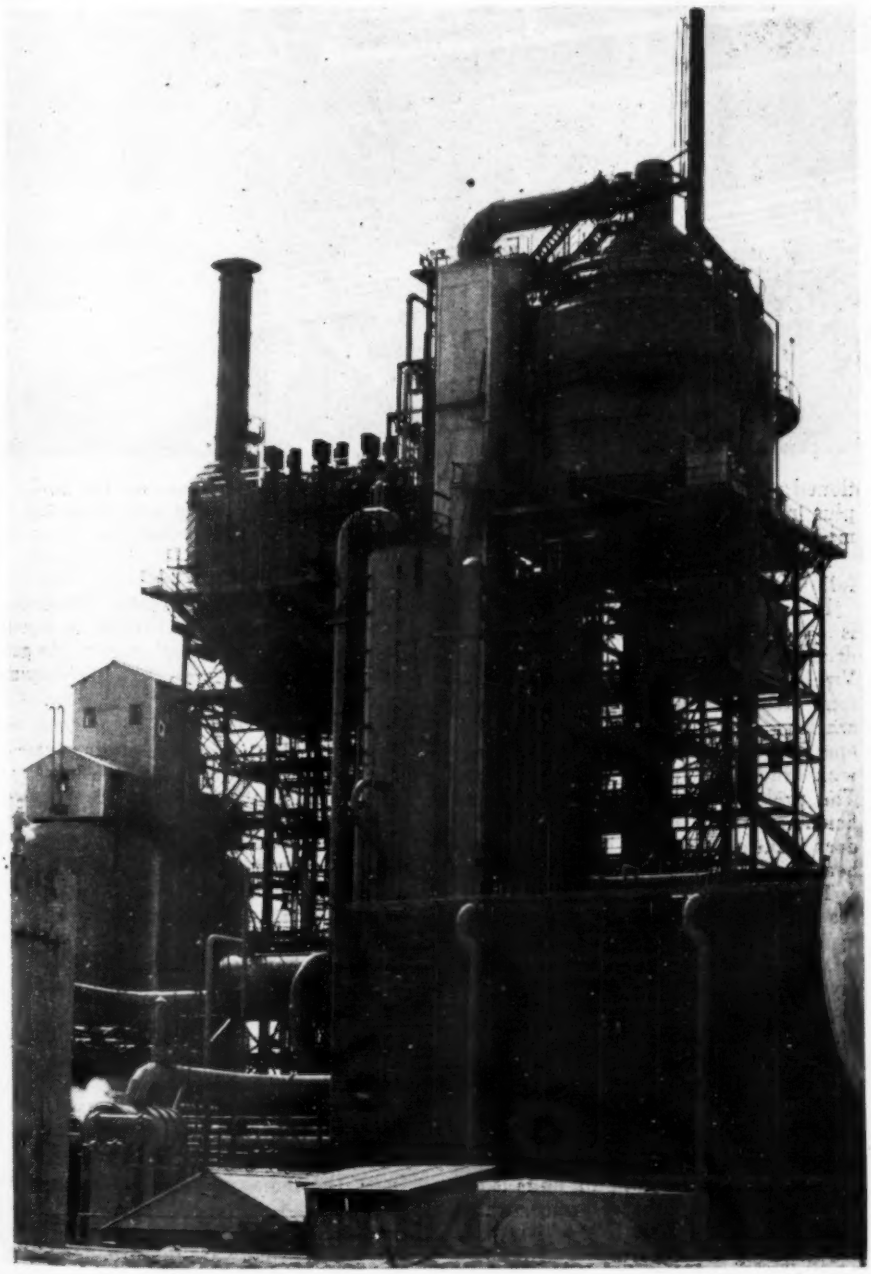
By FRANK H. LOVE, *Managing Editor*

EXCLUSIVE FACILITIES recently added to Republic Oil Refining Company's Texas City, Texas, plant for the manufacture of 100-octane gasoline and other motor fuels consists of five principal units: Gas oil flash unit, thermal reforming unit, catalytic cracking unit, gas concentration unit, and alkylation unit.

The gas oil flash unit is a vacuum fractionating system to which is charged topped and reduced crudes from the crude oil fractionating units. The purpose of this unit is to prepare a gas oil fraction that is charging stock for the catalytic cracking unit. Bottoms from the gas oil flash unit are diverted to thermal cracking or used as fuel oil.

Charge stock to the thermal reforming unit is straight run naphtha from the crude oil fractionating unit. The thermal reforming unit produces a butane-butylene fraction for the alkylation unit. In addition, it produces an 80-octane "all-purpose" motor fuel, also vitally needed by the armed forces.

CATALYTIC CRACKER



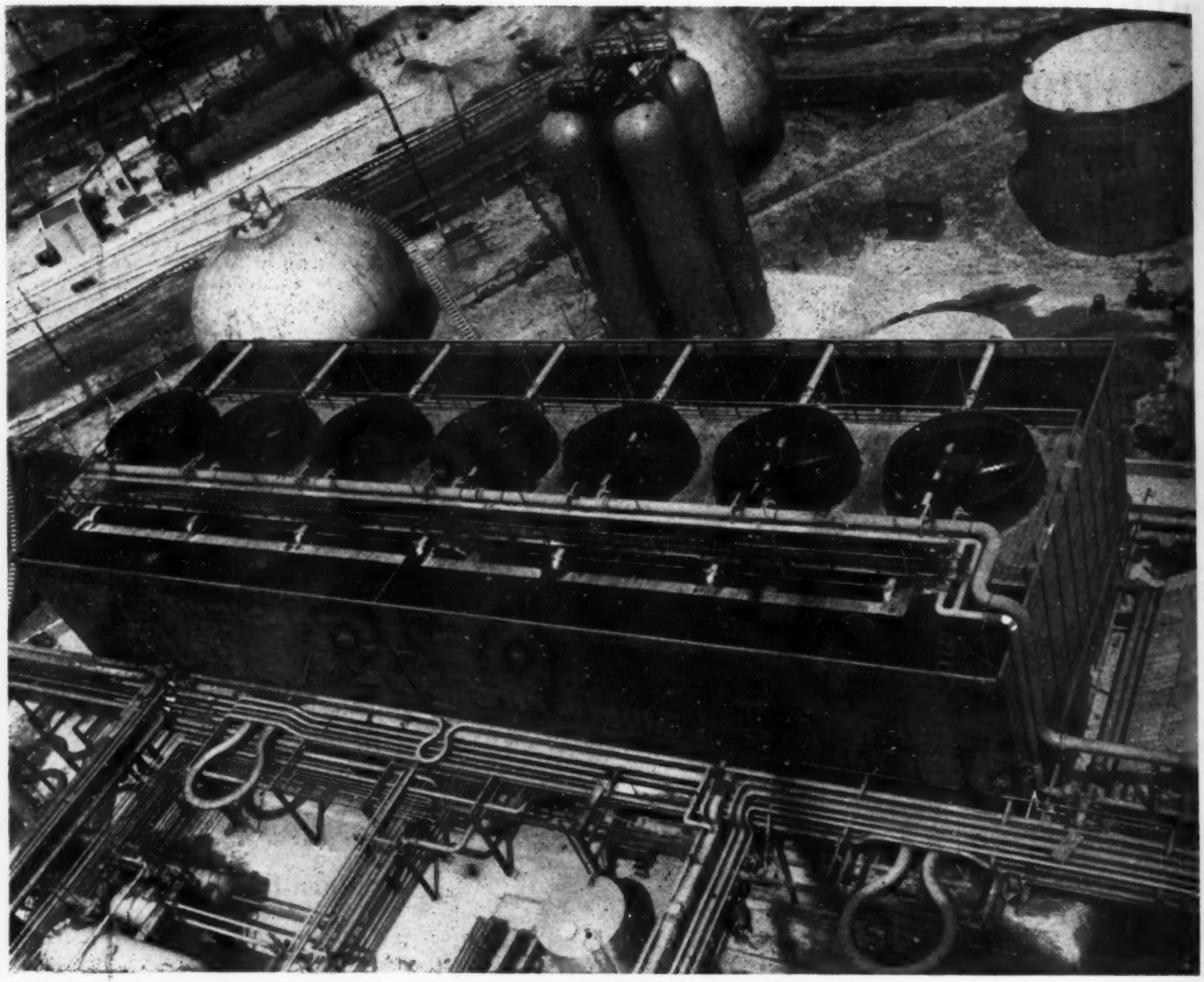
The function of the catalytic cracking unit is twofold: To produce a butane-butylene fraction for the alkylation plant, and a high quality aviation base stock that is blended with the finished alkylate for the manufacture of 100-octane aviation gasoline. The catalyst for this operation is a synthetic clay-like material, finely powdered, which is introduced into the crude oil vapors. It is carried by the vapor into the reactor where the desired reaction takes place. Spent catalyst is picked up by a stream of air and carried into the regenerator where it is reactivated by removal of the carbonaceous deposit. Waste gases are discharged through an electrical precipitator and any remaining catalyst fines are separated and returned, together with the regenerated catalyst, to the reaction zone.

In the gas concentration unit the butane-butylene fraction is separated from the hydrocarbon gases that result from the thermal reforming and catalytic cracking operations. A battery of gas-engine-driven compressors pick up the gas and compress it to 225 lb. at which pressure it enters the gas concentration unit. Separation of the butane-butylene fraction results from the passage of the gases through fractionating towers.

Five units, consisting of gas oil flash, thermal reforming, catalytic cracking, gas concentration, and alkylation, are now on stream at Texas City.

The butane butylene fraction is charging stock for the alkylation plant, which is a catalytic unit employing hydrofluoric acid as a catalyst. Alkylate results from the chemical reaction of isobutane with butylene to produce a liquid product, which is of high quality and necessary in the manufacture of 100-octane gasoline, but the quantity is insufficient to meet the requirements of the armed forces, so it is necessary to blend it with gasoline obtained from catalytic cracking, after which a small amount of tetraethyl lead is added to give 100-octane gasoline.

▼ **No. 1 plant.** Republic's refinery already in existence at the time work began on the five new units in 1942 is referred to as Plant No. 1. In operation were four topping units and two thermal crackers. Charge to the four topping units is approximately 25,000 bbl. of crude oil per day. Capacity of the thermal cracking equipment is about 9000



Birdseye view of one of the cooling towers, looking west from top of the catalytic cracker.

bbl. of reduced crude per day. This charge is not a reduced crude in the strict usage of the term; rather, it is a mixture of thermal reformer bottoms, catalytically cracked, and reduced crude bottoms. Also, feed to the crackers can be segregated as fuel oils instead of being cracked further, should occasion demand, adding to the flexibility of the plant.

▼ **Plant No. 2.** The new plant has as its principal purpose the manufacture of 100-octane aviation gasoline, as mentioned; however, as by-products a 76 plus motor gasoline and fuel oil are made.

Flow through Plant No. 2 briefly is as follows:

From the topping units reduced crude is charged to a 17-plant gas oil flash drum on which a vacuum is maintained. Virgin gas oil is taken overhead; bottoms are utilized for fuel or thermal cracking. A side cut is taken during this operation, which is cooled by exchange with crude oil, and returned as reflux. The preheat thus acquired is not sufficient for direct charge to topping but does make possible the use of a smaller heater on one of the topping units.

There is no heater on the catalytic cracking unit, the gas oil charge being heated to cracking temperature by injection of hot catalyst. Regenerated catalyst at 1000-1100°F. completes the job begun by heat exchange with hot oil from the fractionator.

In preliminary fractionation, effluent from catalytic cracking is separated into heavy bottoms and overhead. The overhead vapor goes to the gas concentration unit for separation into its components.

Naphtha from the topping units is the charge to the naphtha reformer, which has a capacity of 5000 bbl. per day. By debutanizing the reformed gasoline reformed gases are recovered. The debutanized product goes directly to motor fuel blending, reformed gases to the gas concentration plant, and heavy residuum is used as fuel oil.

The gas concentration plant serves as a central unit for segregating gases. The charge to this unit consists of reformed and thermally cracked gases (C_4 and lighter) and compressed gases and liquids boiling below 400°F. from catalytic cracking. The gases are compressed to about 225 lb. per sq. in. gauge and discharged to the absorber. Compressor capacity of 3000 hp. was installed to handle an estimated 15 to 20 million cu. ft. of gas from the catalytic cracker.

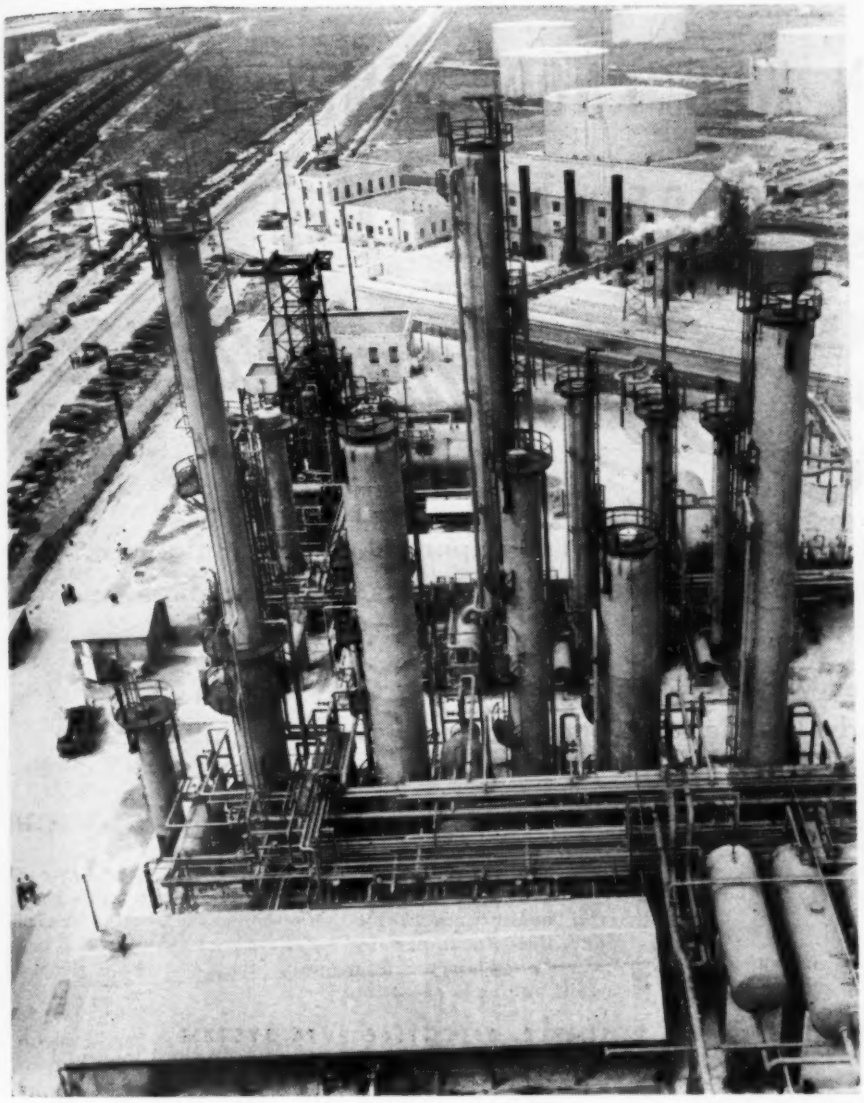
The catalytically cracked gasoline is split into 340°F. endpoint product and a naphtha cut boiling from 340 to 400°F. The former is used as aviation base stock and the latter for motor fuel blending.

After removal of the C_3 and C_4 fractions, the remaining gas is fractionated into C_1-C_2, C_3, and C_4 cuts. The C_1-C_2 cut is discharged to the refinery fuel gas system, as usually are the propanes. The

Japan's oil supply

Damage to oil installations in the Netherlands Indies, chief source of oil supply for Japan, caused an estimated 50 per cent reduction of supplies in 1942 over 1941, it is believed. Repairs made possible some increase in production during 1943 and the early part of 1944, but it is doubtful that production can be maintained to meet Japan's needs.

The Nazi and Scandinavian press reports the supply of oil in Japan sufficient, but not abundant.



Above, birdseye view of gas concentration and alkylation units with office, laboratory, boiler house, and tanks in background. At right, alkylation acid contactor.

C_4 cut is charged to the anhydrous hydrofluoric alkylation unit, which is a unit of standard design of Universal Oil Products Company using an impeller type contactor. Connections are provided so that some C_3 and C_5 olefins can be alkylated in addition to the conventional C_4 cut. Another feature is the removal of accumulated water from the acid by fractionation in a silver-lined tower.

Products available for blending of aviation gasoline are aviation alkylate, catalytic base stock, and C_5.

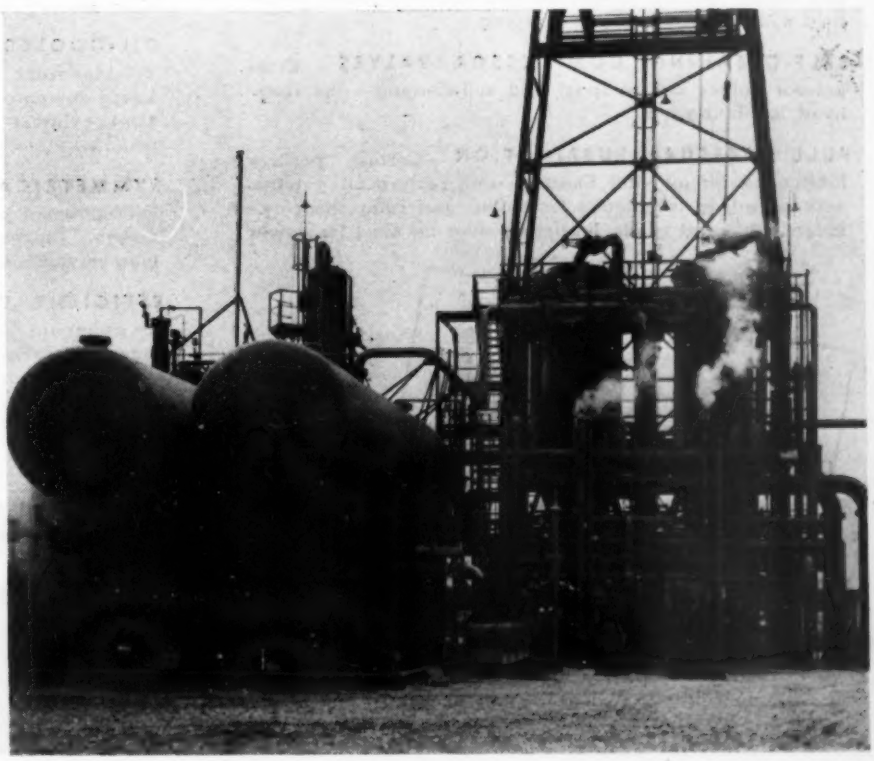
▼ **Plant auxiliaries.** Construction of the new units imposed additional loads on certain existing facilities, making it necessary to increase some auxiliary equipment. To provide greater steam capacity, four new 935-hp. boilers were installed to generate steam at 300 lb. per sq. in. gauge at 75° superheat. Two new wells, 800 ft. and 1100 ft., were drilled to provide drinking and process water, augmenting two similar wells previously serving the plant. Boiler feed water is zeolite softened and acidulated with sulphuric acid. Cooling water, although not softened, is treated with quachrome glucosate for control of corrosion, and with tetraphospho-glucosate to inhibit scale formation.

Other additions to the refinery include new tankage, fractionating towers, cooling towers, increased laboratory and office space.

To conserve steam and reduce fuel costs, turbines used for direct power exhaust steam at 40 lb. per sq. in. gauge saturated. The steam is used in condensing turbines driving circulating water pumps and cooling tower fans. This steam also is used for reboiler heat in gas plant fractionator columns.

The constructing contractor was Frick-Reid Supply Corporation, Tulsa, Oklahoma.

▼ **Officials.** Republic Oil Refining Company executive and supervisory staff are as follows: O. D. Robinson, president; Harland I. Casteel, executive vice president; John H. Toner, assistant to president; John M. Gardiner, vice president; William H. Moreland, secretary-treasurer; J. E. Kelley, vice president in charge of operation; W. R. Holmsten, superintendent; W. P. C. Voiles, assistant superintendent; J. E. Westenberg, director technical service and development department; R. W. Davis, personnel director; Raymond E. Feasel, general operating supervisor; H. Bottomley, chief engineer; D. M. Veale, chief chemist; Dan L. Dodds, supervisor safety and inspection department; T. R. Clement, traffic manager; R. H. Armstrong, purchasing agent; John Tracy, manager insurance and claims department; R. H. Hogaboom, fire chief, and N. W. Nelson, chief of guards. ★ ★ ★



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PRECISION BEARINGS—All main and pin bearings are the precision type, assuring better load distribution and longer life; are renewable and interchangeable in the field without hand fitting or scraping.

SELF-CLEANING COMPRESSOR VALVES—Compressor valves are compact and self-cleanng—the long-lived, low-lifting type.

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DUAL LUBE OIL FILTERING—To further assure bearing "health" and trouble-free operation, lube oil is cleaned and decontaminated by full flow metal edge filter and waste-pack bleeder filter. Both filters are easily cleaned while engine is operating.

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SYMMETRICAL PISTONS—Streamlined scavenging, with directed air flow, permits symmetrical piston crown design. Thus heat is uniformly dissipated to further prolong service-life of rings, cylinders and pistons.

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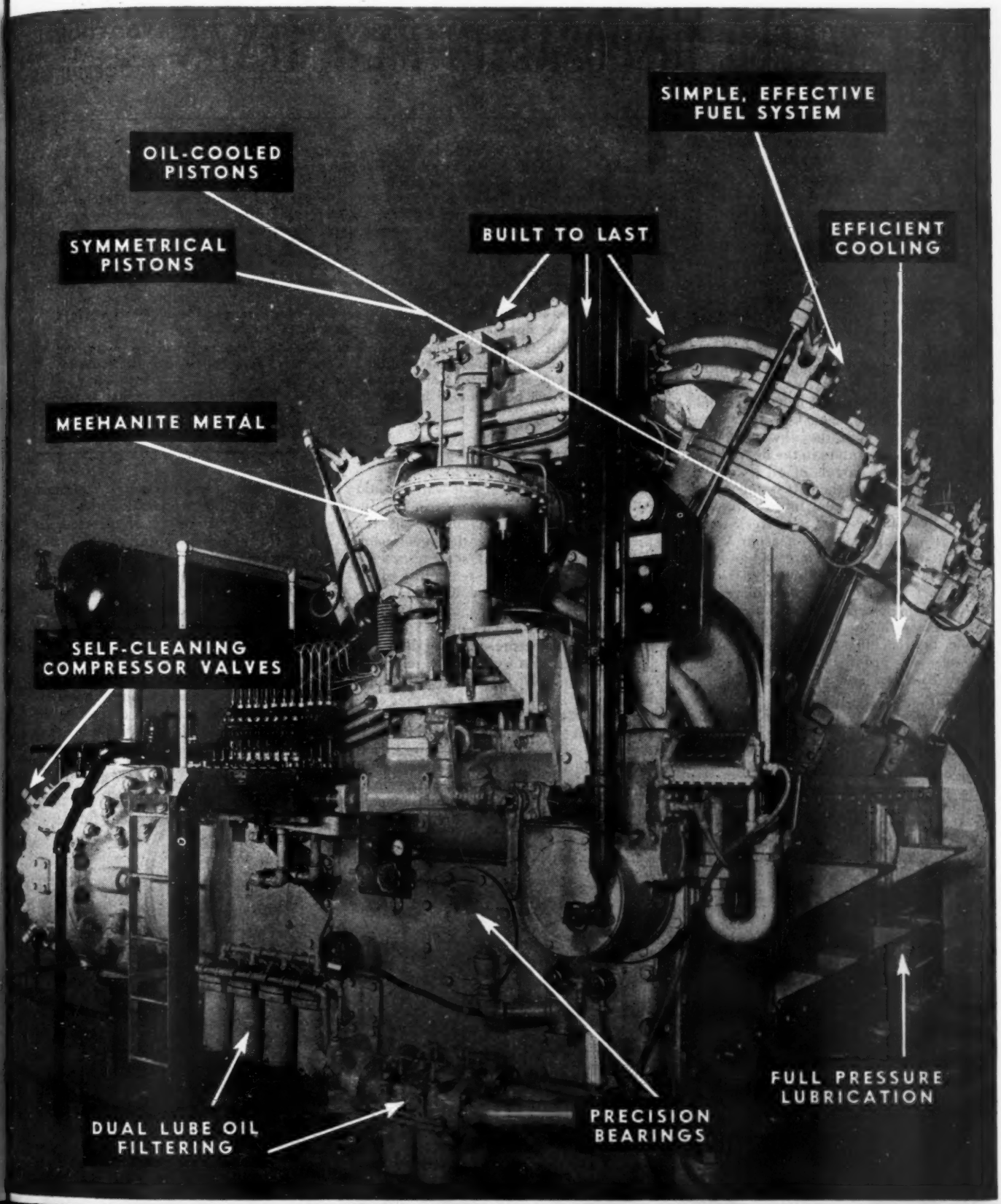


by Cooper-Bessemer

SALT WATER DISPOSAL IN EAST TEXAS

Development of methods for the disposal of salt water produced with crude oil has been rapid in the petroleum industry. One of the largest and most important systems of disposal is now in the final stages of development and construction in the East Texas field. The value of the program to the field even at this early stage of its existence is evidenced in a reduced rate of pressure drop in the field, increased production, and an ultimate high reservoir depletion percentage.

A distinct shortage in technically and practically trained personnel in the salt water disposal field has resulted in organization of classes in salt water disposal in the East Texas field. These classes were organized through the cooperative efforts of the East Texas chapter of The American Petroleum Institute, the public schools of the East Texas area, the State Board for Vocational Education, and the engineers engaged in salt water disposal work of various companies in the field.

The first part of the following article describes the organization of the classes and presents an outline of the material used in the class work. Following the introduction is Section A of Chapter I of the course complete with illlustrations. Succeeding installments will be published in subsequent issues of The Petroleum Engineer as presented to the classes.

—The Editor.

EXCLUSIVE THE gigantic East Texas oil field, famous for its size, early history, and production record, is a laboratory for numerous experiments in production methods, new techniques in well servicing, and other engineering features. Its latest venture is in keeping with its former records of greatness. This time the East Texas field becomes the world's largest laboratory for the experiment in subsurface disposal of salt water. True, this method of disposal has been tried, and with some success, in other fields, but never before on such an elaborate scale.

In the early development of the field the problem of disposal of salt water produced along with the oil was of minor importance. Operators in the field, thinking in terms of barrels of oil produced, simply impounded the salt water in surface ponds constructed in any convenient gully, and released it to fresh water streams during the rainy season. As the volume of production increased and reservoir pressure declined, the encroachment of water from the west increased, resulting in lowering of oil-water ratio.

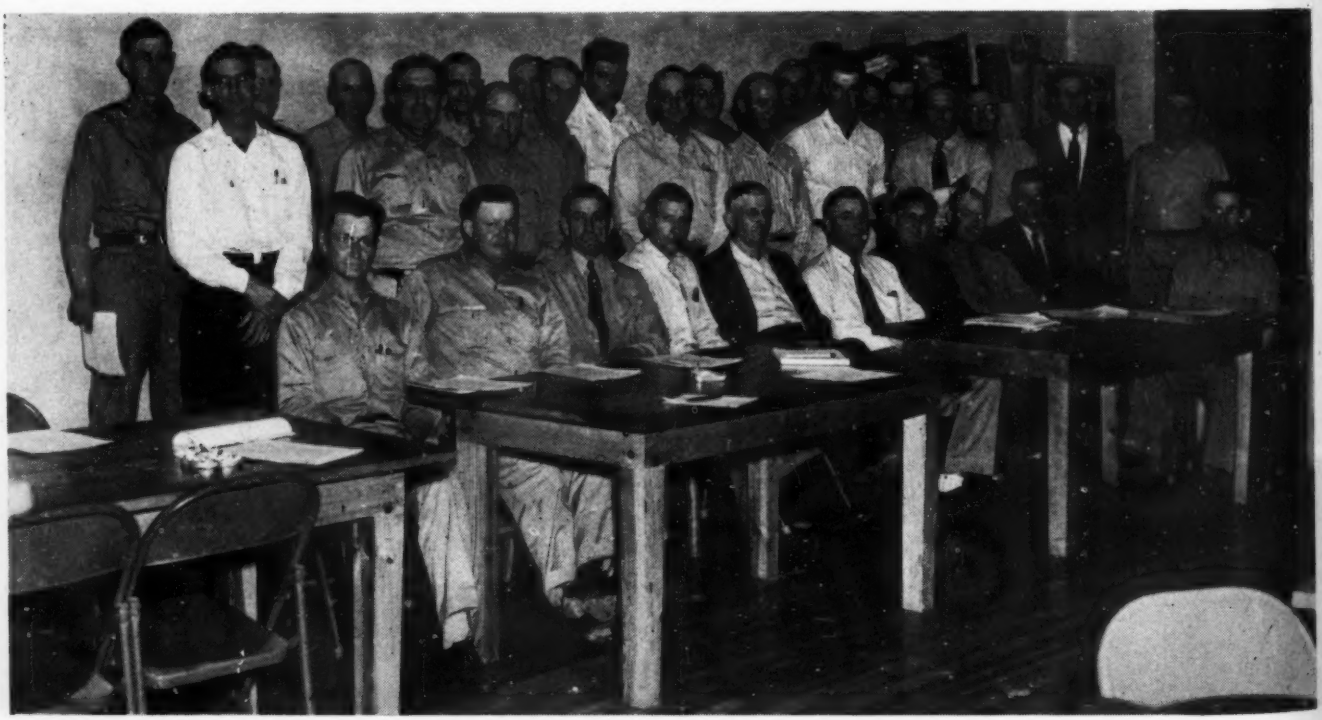
Engineers in the field, alarmed at the rapid encroachment of water and the increase in production of salt water, warned owners and producers that the problem of disposal of salt water would be one of major importance in the future. Realizing the magnitude of the problem and following the recommendations of engineers, full-scale tests were carried out to prove the feasibility of returning salt water to the Woodbine formation from which it was produced. This method of disposal has proved so successful that at the present time there are 64 active injection wells in the field with an average daily injection of 325,582 bbl.

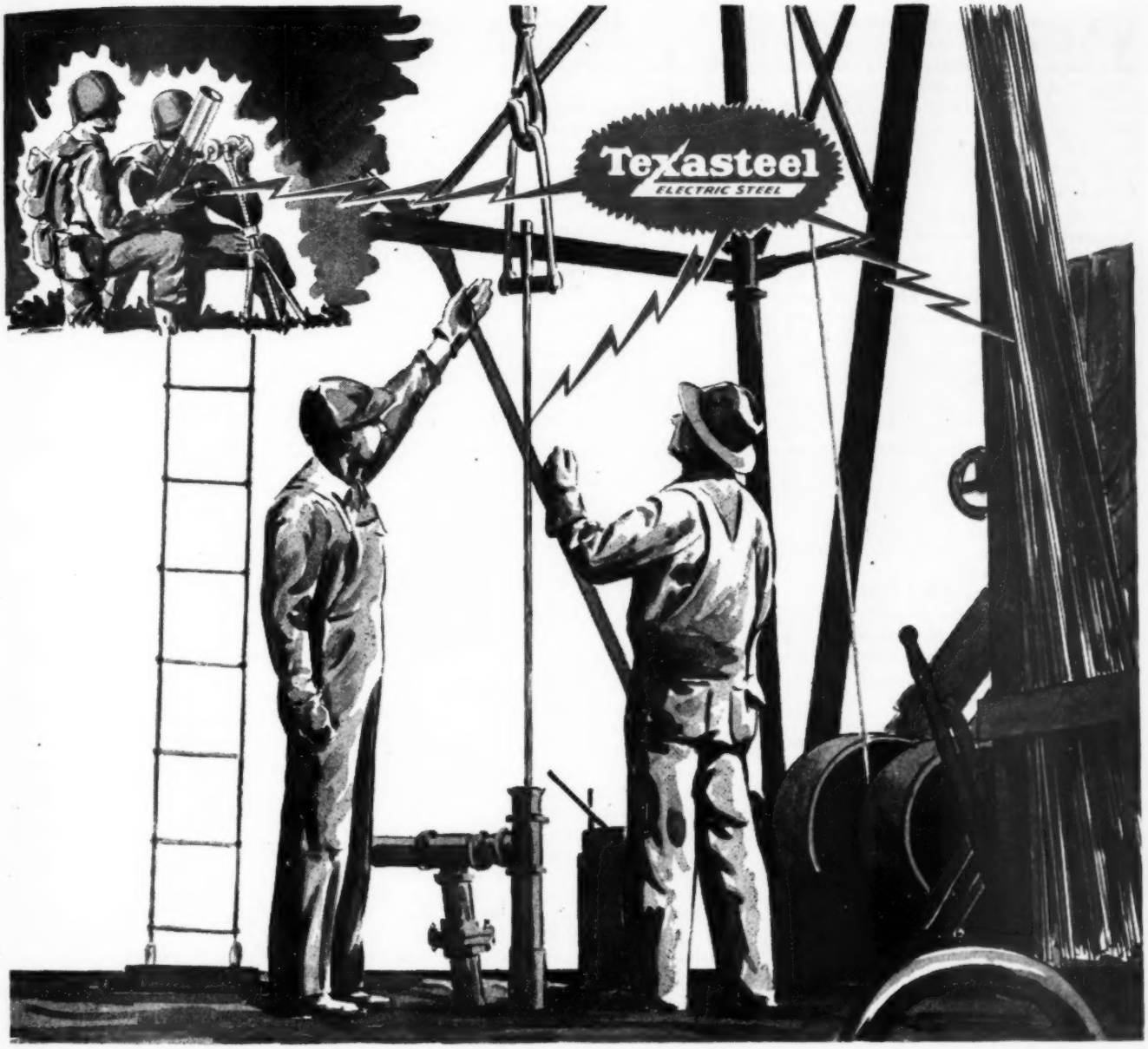
In order to bring about a better understanding of the problem, with all its complexities, classes are being organized throughout the field, in cooperation with the East Texas Chapter of the American Petroleum Institute, the public schools of the entire East Texas area, and the State Board for Vocational Education.

Following the preparation of a course outline by a committee of men familiar with subsurface disposal of salt water, announcement of the course, together with the course outline and a nominating blank, was mailed to all operators in the field. This was done in order to allow each company the privilege of recommending individuals from their organization who would be most concerned with the disposal problem. The response received from these announcements enabled the coordinator to determine the desirable location for classes, number of men who would enroll, and the number of teachers required. At the present time two classes are under way at Kilgore, one at Gladewater, and another is to be started at Overton in the near future.

The data and information contained herein has not been approved nor validated by the Topical Committee on Vocational Training of the American Petroleum Institute. It has been sponsored by the State Board of Vocational Education in Texas in cooperation with the East Texas Chapter of the American Petroleum Institute, and is based upon data and experience arising from current operations in the East Texas field and is intended for instructional purposes in that area.

Members of the first class in salt water disposal organized at Kilgore, Texas.





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The plan to be followed throughout the course is to ask individuals who are specialists in their fields of work to come in and teach certain units of the course. For example a leading geologist and a petroleum engineer would be called in to teach Chapter I, which covers the geology and reservoir conditions of the East Texas field.

A similar plan will be followed in the preparation of the course material. Individuals recognized for their ability and knowledge of certain phases of the injection system will contribute information, which will be mimeographed and distributed to members enrolled in the classes. Visual aids, charts, maps, slides, and other materials will be brought into the classroom from time to time to enhance the value of the course.

The following is an outline of the class work:

I. The East Texas reservoir
  A. Geology
    1. Origin of oil and gas
    2. Sediments and sedimentary rocks
    3. Stratigraphic sections
    4. Structural traps
    5. Stratigraphic traps
  B. Graphic representations of petroleum reservoirs
    1. Contour maps
    2. Cross-sections
    3. Principles of electrical logging
  C. Production history
    1. Statistics
    2. Reservoir behavior
  D. Characteristics of the Woodbine reservoir
  E. Water drive

II. History and development of salt water disposal
  A. Surface
  B. Subsurface
    1. Early experiments
    2. The East Texas Salt Water Disposal Company

III. The open type salt water disposal system
  A. The gathering system
    1. Effect of topography
    2. Line capacity
    3. Materials
    4. Collecting tanks and pits
    5. Maintenance
  B. The treating plant
    1. Design
      a. Aeration system
      b. Chlorination system
    2. Characteristics of salt water
    3. Chemical treating
    4. Sedimentation
    5. Filtration
  C. Injection well and equipment

IV. The closed type of salt water disposal
  A. The gathering system
    1. Pressure treaters
    2. Pipe
  B. The treating system
    1. Pressure vessels
  C. Injection well and equipment

V. Operating the disposal system
  A. Gathering
  B. Treating
  C. Injecting

VI. Economics of salt water disposal
  A. Cost per barrel
  B. Transfer of allowable
  C. Increased ultimate recovery

Executives and engineers of the East Texas Salt Water Disposal Company are giving wholehearted support to the study. W. S. Morris, vice president and general manager of the company, served as a member of the training committee in the final preparation of the course outline. Members of his staff, Harold Dial, chief engineer, and R. J. Bethancourt, electrical engineer, are serving as head instructors for the Kilgore classes. Ralph Ludwick, petroleum engineer for Stanolind Oil and Gas Company, is head instructor for the class in Gladewater.

CHAPTER I

EAST TEXAS RESERVOIR

Section A—Geology

▼ **Origin of oil and gas.** The close relationship between oil and gas is apparent from their association and similarity in mode of occurrence. The problem of the origin of these hydrocarbon compounds has been a subject of much speculation; however, the most commonly accepted theory considers that petroleum has been formed by the decomposition of organic matter buried in the rocks. This organic material, whether vegetable or animal, was incorporated in sediments at the time of their deposition and therefore the importance of geology as a basis for understanding the occurrence of oil and gas is evident.

▼ **Sediments and sedimentary rocks.** All rocks may be classified in three great groups:

A. Igneous—comprising all earth materials that were once in a molten condition.

B. Sedimentary—comprising all earth materials deposited by water, wind, ice, etc.

C. Metamorphic—comprising all rocks of the foregoing groups that have been altered in texture and composition.

Most organic matter contained in the rocks of the earth's crust was incorporated in sediments at the time of their deposition; therefore we may confine our interest, mainly, to sedimentary geology.

Sediments are products of rock weathering. Under the action of the weather even the most resistant rocks crumble or decay in the course of time. Many processes, both mechanical and chemical, contribute to this disintegration or decomposition of rock masses; however, the direct action of the weather is the most important factor.

The products of rock weathering are moved from their places of origin by various agents of transportation. The greatest of these agents are water, wind, and ice. Our interest lies mainly with water-transported sediments.

In the process of transportation by water, sediments generally become well sorted and are accumulated in vast quantities in their ultimate resting place, the sea. As a result of this sorting they may be classified according to texture and composition. Although sediments commonly grade from one kind to another without a noticeable break, the most common sediments and their corresponding rock types are as follows:

Sand	Sandstone
Clay	Shale
Organic or chemical	Limestone, anhydrite, etc.

The most noteworthy characteristic of sediments or sedimentary rocks is their division into layers or beds, i.e., their stratification. The individual particles are generally well rounded as a result of

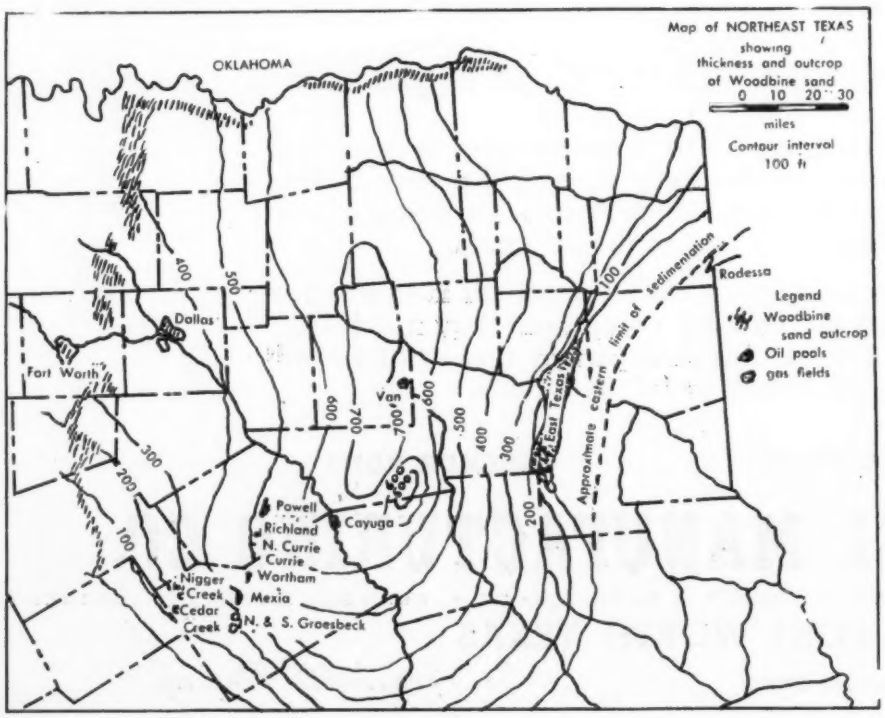
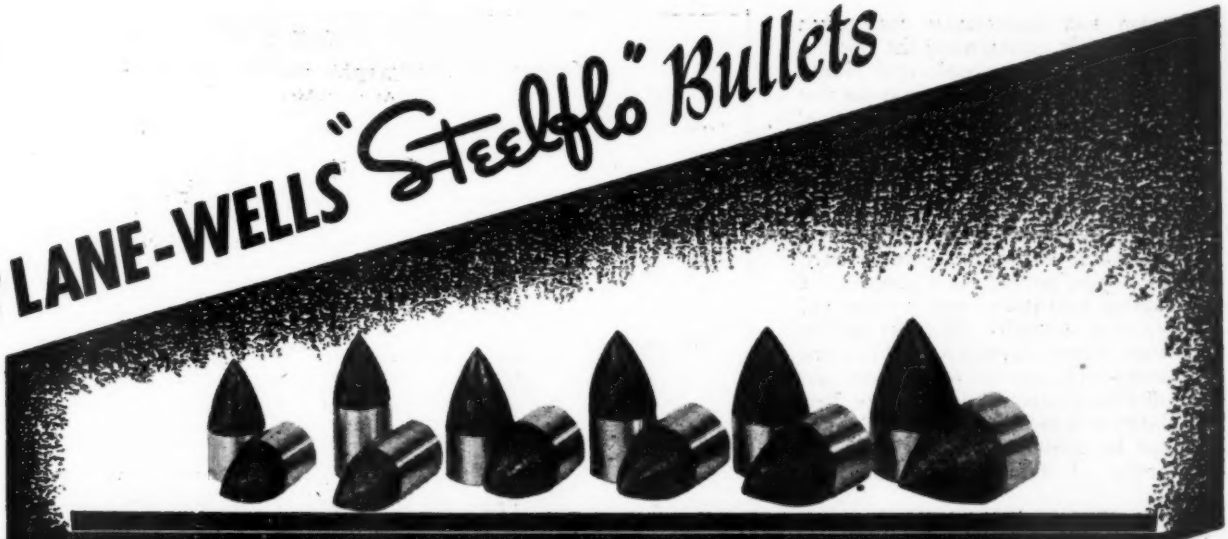


Fig. 1.

These LANE-WELLS "Steelflo" Bullets



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The results *you* wanted from Gun Perforating Service are the "reasons why" Lane-Wells developed the ogival-point "Steelflo" bullet. *You* asked for a strong extreme point that would not chip. *You* asked for a bullet that would hit harder and penetrate deeper into formation. *You* asked for a point that would flow metal back from around the perforation to reduce the danger of damage to tools.

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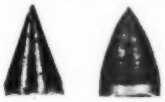
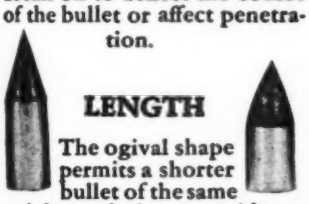
STRENGTH OF POINT



The outline shape of the ogival-point produces a thicker extreme point of greatly increased strength. No chips break off to deflect the course of the bullet or affect penetration.

LENGTH



The ogival shape permits a shorter bullet of the same weight and thus provides a greater distance of travel when the base remains the same.

CENTER OF GRAVITY

The center of gravity is forward to keep the bullet traveling in a straighter path.

PERFORATION

The ogival-point flows displaced metal back into a tight bead to produce a cleaner perforation with less danger of damage to tools run after perforating.

abrasion and furthermore they often contain fossils representing the remains or impressions of animals and plants. Beds or strata of sediments or rocks that may be grouped together because of similar age and associations are termed formations.

▼ **Reservoir rocks.** Commercial accumulations of oil and gas occur in porous or permeable sediments or rocks only. By definition, porosity is a property of containing void spaces and is expressed in per cent. Actually, all rocks exhibit a certain degree of porosity and in some instances rocks may be very porous and yet offer no productive possibilities. Permeability is a measure of the resistance offered by sediments or rocks to the movement of fluid through the pore spaces.

From the above brief classification, sand or sandstone most commonly offers favorable conditions of porosity and permeability and in addition porous limestones are of importance. Sediments or rocks of these types form, by far, the most important reservoir rocks for accumulations of oil and gas.

▼ **Stratigraphic section of the East Texas Basin.** The formations penetrated down to a depth of 10,000 ft. in the East Texas area and their approximate thicknesses are shown in Table I. A detailed review of each formation is beyond the scope of our present study, consequently we may confine our interest to formations containing reservoir beds and especially to the Woodbine formation, which constitutes the producing formation of the East Texas field and other fields within the confines of the East Texas basin. Refer to Fig. 1 which shows the areal distribution of the Woodbine sand and its thickness in the East Texas basin.

TABLE I

Generalized stratigraphic section, East Texas area

Period	*Group*	*Average thickness, plus and minus*	*Formation*
			Crockett, clay and marl
		250	Sparta, sand and shale
		50	Weches, shale
	Claiborne	300	Queen City, sand
		80	Reklaw, shale
Eocene			Carrizo, shale
	Wilcox	1400	Wilcox, sand
	Midway	750	Midway, shale
	Navarro	1500	Navarro, shale and sand
		500	Upper Taylor, shale
	Taylor	200	Pecan Gap, chalk
Upper		900	Lower Taylor, shale
Cretaceous	Austin	300	Austin, chalk
	Eagle Ford	300	Eagle Ford, shale
	Woodbine	0---750	Woodbine, sand
	Washita	30	Grayson, shale
		750	Georgetown, lime
			Kiamichi, shale
Lower	Fredericksburg	175	Goodland, lime
Cretaceous			Walnut, shale
(Comanchean)		300	Paluxy, sand and shale
		900	Upper Glen Rose, lime and shale
	Trinity	450	Middle Glen Rose, anhydrite series
		700	*Lower Glen Rose, Oolitic lime and shale
		2000	Travis Peak, red sand and shale

*Includes Rodessa and Pettit zones, found productive in a number of East Texas fields.

We have seen that oil originates in sediments and that commercial accumulations are found in reservoir rocks. One additional requirement for accumulation of oil or gas in significant quantities is a trap in which the hydrocarbons may gather, but cannot escape. As oil is formed in disseminated particles, a concentration must be effected before a deposit of commercial proportions is possible. As a result of compaction of sediments, capillarity, and the difference in gravity between oil and water, oil migrates from source beds into reservoir beds and thence into traps.

As we have seen, the raw material from which oil is made is deposited on the ocean floor. If the oil that is formed is to migrate to a trap, the formation of sedimentary material must be porous. This being true, it will be saturated with ocean water. As the oil is formed later it

Fig. 2. Top. Fig. 3. Center. Fig. 4. Bottom.

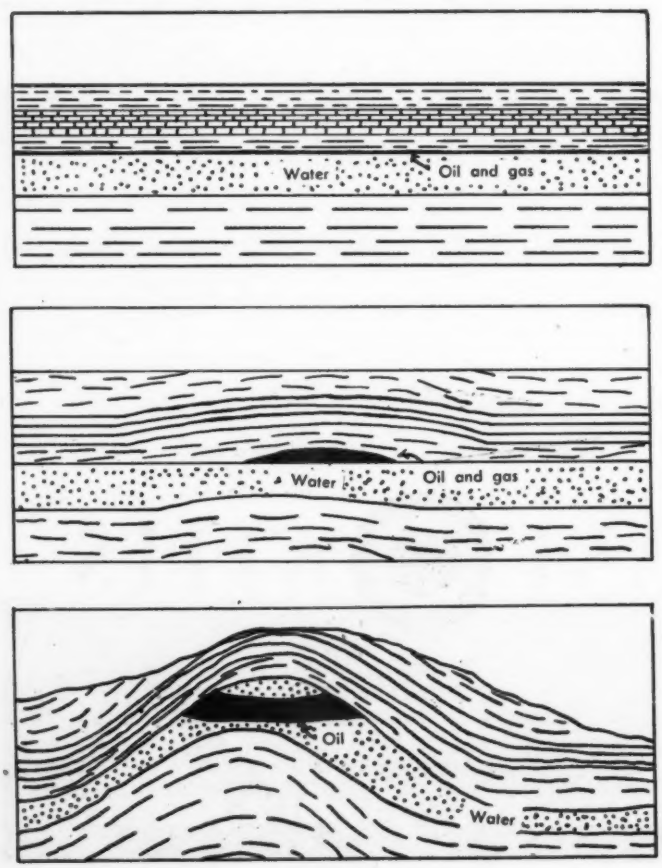
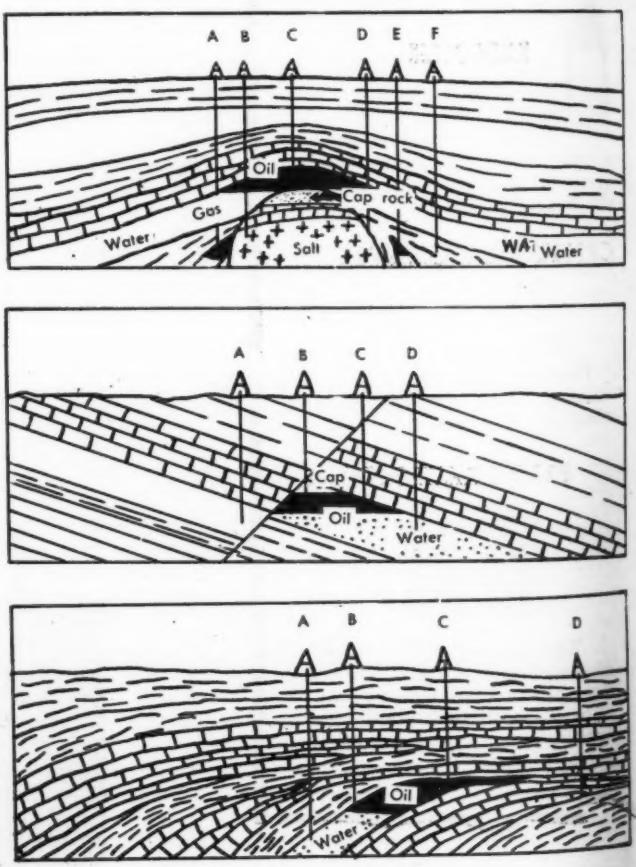


Fig. 5. Top. Fig. 6. Center. Fig. 7. Bottom.



OILING THE WAR
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HUGHES TOOL COMPANY
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will float on this water just as oil floats on water anywhere else, and it will float as high as the overlaying impervious formation will permit. Accumulations are formed when the oil floats into a trap and is held there by the force of the water on which it is floating.

This tendency of the oil to move in response to water pressure and buoyancy should be kept in mind in the study of the East Texas field, where the water drive plays such an important part in petroleum production.

Two types of traps are recognized.

▼ **Structural traps.** Time does not permit us to investigate the realm of structural geology, which deals with the arrangement of rocks in the earth's crust. We will accept the fact that sediments, which were deposited in layers, do not always maintain their initial attitude but are subject to deformation. Any rock mass, when subjected to sufficient pressure must either bend or fracture. The resulting structural features provide conditions favorable to the migration of oil and gas in porous rocks due to the selective action of gravity on rock fluids. Structures formed as a result of bending of rock strata are termed folds.

Kinds of rock folds. The following are types of rock folds:

Anticline. This is a simple fold arched upward and is one of the most important types of structural traps in which oil may accumulate.

Examples: Magnolia field, Arkansas; Chapel Hill field, Texas; Quitman field, Texas.

Refer to Figs. 2, 3, and 4, illustrating the growth of an anticline and accumulation of oil and gas.

Synclines. These are inverted anticlines or troughlike folds. Because they represent low structural elements they are of little importance as petroleum reservoirs except in the Appalachian area where oil is occasionally found in the bottoms of the troughs, in water-free formations.

Monocline. This feature may be described as one limb of a fold with the layers dipping in one direction only. Alone, such structures do not form favorable petroleum reservoirs but in conjunction with other features form many important fields, including East Texas, Talco, etc.

Domes. This is a special type of anticline, with the beds dipping downward in all directions from the apex. They form many important oil fields including Van, Hawkins, Coke, etc. Salt domes are special types of domal structures in which the motivating force in their formation is attributed to salt. These structures, which are invariably characterized by complex faulting, comprise most of the important petroleum reservoirs of the Gulf Coast area.

Examples: Conroe, Hastings, Hackberry, Goose Creek, Anahuac, etc.

Refer to Fig. 5 for an example of accumulation in a salt dome.

Faults. When subjected to sufficient pressure rocks may break as well as bend. Generally, the bending of rock strata is accompanied by breaking and such breaks, along which displacement occurs, are called faults. In this area we are concerned only with tensional or normal faults and numerous oil and gas fields have been found in fault traps. Inclined porous beds, permitting migration, are essential. In addition, displacement along the fault must place impermeable beds against the porous zone, which will trap the rock fluids and prevent their escape.

Examples: Mexia, Wortham, Talco, Sulphur Bluff, etc.

Refer to Fig. 6, which illustrates an example of accumulation against a fault.

▼ **Stratigraphic traps.** Traps of this type, in which oil and gas may accumulate, result from termination of the porous reservoir bed against impermeable material due to sedimentary variations. Such traps are, in most cases, associated with structural features that provide dipping strata favorable to migration. Stratigraphic traps may result from a "pinch-out" of the porous zone, meaning that the porous bed grades laterally into impermeable material.

Examples: Paluxy reservoir at Chapel Hill; sensing sands of the Stephens and Dorcheat fields, Arkansas; river beds of Kansas.

Buried shore line features representing the depositional limits of the reservoir beds may represent the most important group of petroleum reservoirs in this class.

Examples: East Texas field, which will be discussed later in more detail.

Fig. 7 is an example of a shore line accumulation.

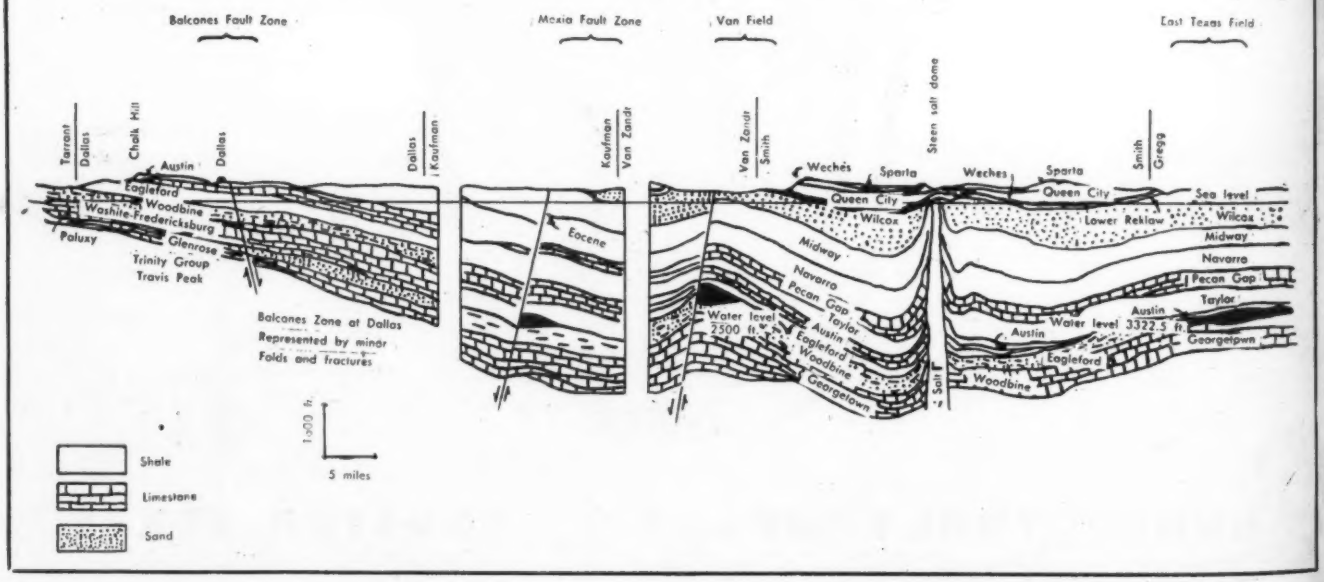
The effect of unconformities. The erosion of inclined porous beds and subsequent deposition of impermeable sediments may provide favorable conditions for petroleum reservoirs.

Refer to Fig. 8 for a generalized east-west cross-section of the East Texas Basin from Fort Worth to the East Texas field. ★★★

Axis loses vital oil resources

The Axis nations of Europe lost about 60 per cent of their refined oil products when the Russians captured the Ploesti oil fields in Romania. Ploesti had an annual refinery capacity of 10,000,000 tons, which had been cut to 2,000,000 by the end of July due to prolonged and concentrated Allied bombing before the capture. The wells suffered only slightly but the refineries were badly damaged by the Allied attack. The speed of restoration of the refineries will depend upon the need for oil, which at present does not appear to be great. Estimates from London say that Germany's total capacity of all refined oil products is now 7,000,000 to 8,000,000 tons yearly, a mere trickle for requirements of modern warfare. Germany's major strategy throughout the war has been based on her need for oil.

Fig. 8.



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With ONE Set of BAASH-ROSS "DU" ROTARY SLIPS

you can drill from grass-roots to completion *by simply changing liners!*

No waiting for new slip bodies when pipe size is changed!

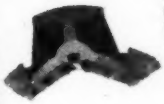
In designing the "DU" Slips, Baash-Ross engineers incorporated a unique performance feature that cut Rotary Slip costs to an absolute minimum...with *one* set of "DU" slip bodies a wide range of pipe sizes could be handled *simply by changing the liners.* Even in pre-war days this advantage was a vital one, for it meant that one set of slips could be used throughout the drilling and completion of an average well. It was only necessary to replace the inexpensive slip liners every time pipe size was changed instead of buying an entirely new set of slips, as is necessary with conventional units.

Today, this economy feature is paying *double* dividends to owners of "DU" Slips, for—besides cutting slip costs to the bone—it means that operators using "DU" Slips are not having to hold up their drilling programs when they change pipe sizes while they wait for delivery of hard-to-get slip bodies. They simply install a new set of liners in the "DU" body—a quick, easy operation—and are ready to go. It's not only far cheaper, but also eliminates delay and conserves metal!

Look at These "DU" Slip Advancements!

POSITIVE SLIP ALIGNMENT: All segments work together as a unit. Even though off-center pipe pulls on one segment, others also drop in perfect alignment. Safeguards pipe. Speeds roundtrips.

ADVANCED GRIP DESIGN: Small truncated pyramids minimize pipe penetration. Also, grip area is relieved vertically and horizontally to eliminate stress concentrations that cause pipe damage.



SAFETY LINER MOUNTING: Liners held by deep recesses in body to insure transmission of all stresses directly to slip body. No bolts or pins to sheer and drop liners in hole. Yet liners are easily replaced with minimum effort!

SAFETY HANDLES: Handles are unusually husky and have large loops that protect crew's hands from smashing against table should elevators strike handles. A vital safeguard!

UNIQUE FLEXIBLE HINGE: Maintains rigid vertical alignment, yet permits lateral adjustment for perfect fit in master bushing bore.

FOR EXAMPLE...

By simply changing liners this 4½" "DU" Slip Body — Fits 4½" Pipe — ...or 3½" Pipe (or tubing) — ...or 2⅞" Pipe (or tubing) — ...or 2⅜" Pipe (or tubing)

From Drill Pipe to Tubing with the same slip bodies!

And this is just one of several unique "DU" Slip advantages that are doubly valuable in meeting today's drilling problems. With today's manpower problems operators are finding that, even with green hands in the crew, they can run pipe faster with less damage when using "DU's" ***because these slips are completely unitized for a uniform setting every time.***

In contrast to conventional two- or three-man slips where one slip can be set lower than the rest to cause uneven gripping pressure and costly pipe damage, all three slip segments in the "DU" are unitized into *one* unit. All segments *automatically* set together and release together, maintaining exact vertical alignment at all times. This means that *any* crew—experienced or not—can set "DU" Slips perfectly every time, assuring faster round trips, a better grip on the pipe and minimum risk of damage. Still other "DU" advantages are outlined at left.

Baash-Ross "DU" Slips are available in two types—"Regular" with liners 12" long for wells to 8000 ft. (sizes for all pipe diameters to 7") ... and "Long" with 16" liners for deeper wells (sizes for pipe diameters to 5-9/16"). *Also in special sizes to fit smaller tables of portable rigs.* Get the full story on these advanced slips from your nearest Baash-Ross distributor. Or write direct!

PLASTIC PLUGBACK IN EAST TEXAS

By C. C. PRYOR, *Associate Editor*

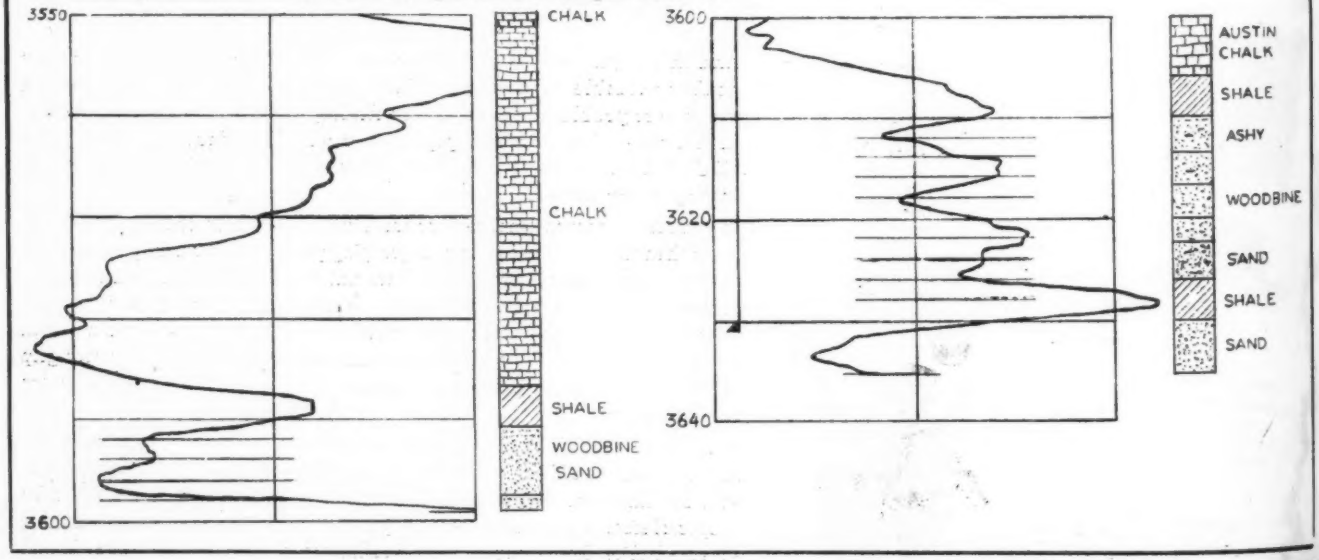
EXCLUSIVE EXCLUSION of salt water in wells by the use of plastics has been widely adopted in the East Texas field with results generally satisfactory to the operators. The simplicity of application and ease with which the plastic is drilled makes it adaptable for this type of work. Many wells in the East Texas area produce oil from a relatively shallow section either exposed below the casing seat or through casing perforations. Water intrusion is usually from the bottom of the sand and gradually cones into the well bore. The percentage of water produced from the well may or may not increase rapidly depending on characteristics of the particular area produced by the well. In some instances wells have produced over a long period of time with a very low percentage of water, although at the same time nearby wells have had to be abandoned because of a high rate of water intrusion. Plastics have aided greatly in overcoming this condition by plugging not only the bottom of the hole below the casing shoe, but perforations in the casing as well. The recovery per acre-foot on recompletions in the East Texas field is estimated at an average of about 750 bbl. Dependent upon this acreage figure, workover expense is comparatively small in ratio to the ultimate yield of the well.

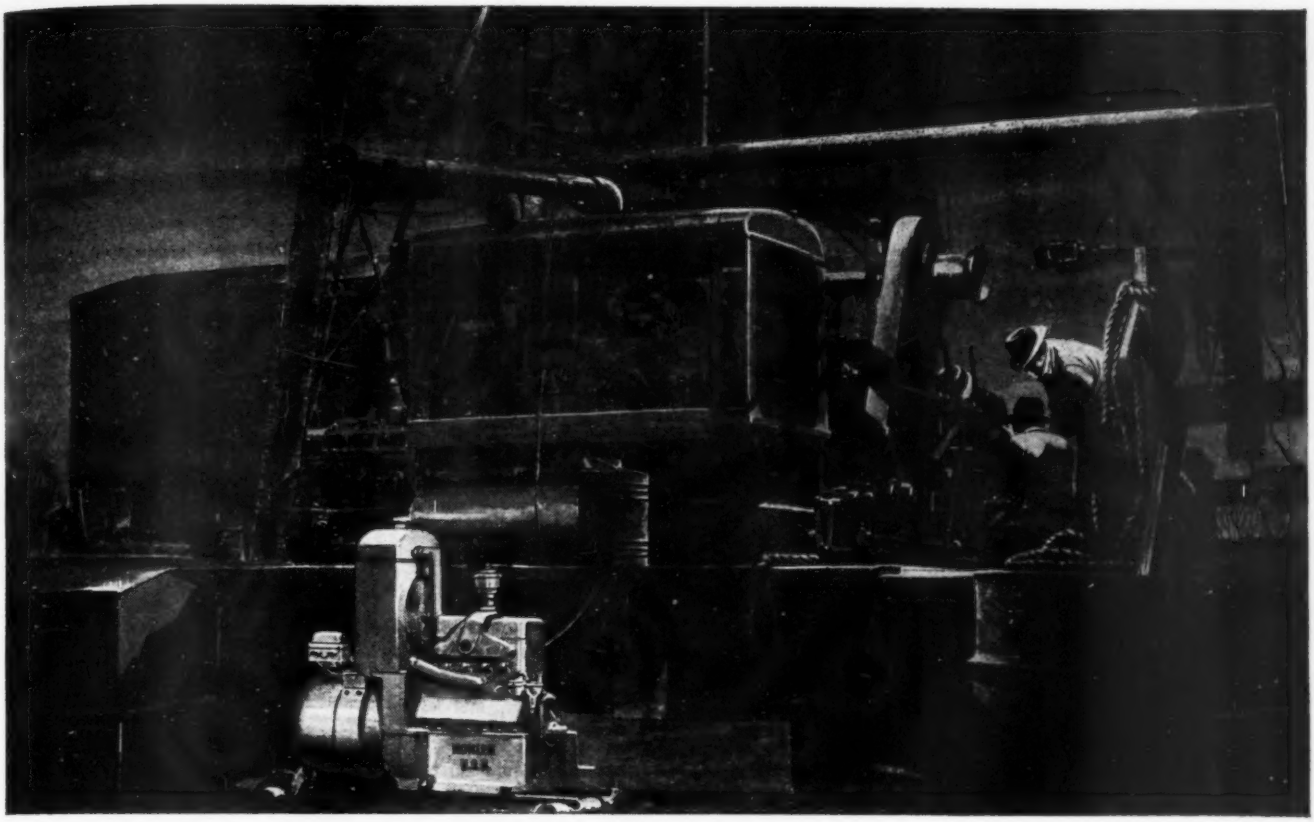
One of the most important prerequisites in preparation for plastic plugging is subsurface data of the section to be plugged. In the East Texas field the amount of sand left open in open hole, or perforated after plastic plugging is mainly dependent upon the well location in the field. The wells with clean sand giving high potentials on electric logs, or low radioactive values on radioactivity logs, require small zones for recompletion. If the sands are ashy or shaly, as indicated by the higher radioactive values on the logs in Figs. 1 and 2, a larger section usually must be opened for maximum efficiency. The well in Fig. 1 was previously completed at 3637 ft. with a liner having a screen of 44/100 mesh. Seven-inch casing was cemented at 3631 ft. Before plugging the well was producing 35 per cent water. Fifty-four gallons of plastic were used in the first job, but the plastic apparently did not penetrate the screen and 56 gal. more were required. The well was plugged back to 3611 ft. After allowing the plastic to set the well was drilled out with a rotary to 3614.5 ft. and perforated with 10 holes from 3610 to 3614 ft., and production of pipe-line oil was obtained. Successful recompletion of the well in the ashy sand was due to a great extent to the subsurface data supplied by the radioactivity log. The log of the well shown in Fig. 2 also aided greatly in determining how much the well should be plugged back, how much it should be drilled out with the rotary, and the proper zone to perforate for production.

The positive displacement dump bailer has provided the best method of placing the plastic on bottom in the well. After the material has hardened and an insufficient quantity has been used, additional plastic is dumped until the desired height is reached. Preparation of a well for plugging with plastic includes cleaning the exposed surfaces to which the plastic must bond to accomplish satisfactory results. The bonding property of plastic to steel renders it an ideal plug for liners and casing. Drilling mud or filter cake not only prevents the plastic entering the sand, but causes an increase in setting time and formation of small unconsolidated globulars of polymerized plastic. Plugging back with plastic through liners and perforated casing, being done in increasing numbers of wells in East Texas, requires that the mud and filter cake be removed from behind the liner by one of the several methods in common use including reverse circulation, acidizing the liner section, hydrostatic bailing, or washing through an inverted swab. The most popular of these methods is the hydrostatic bailer. In plugging jobs requiring that the plastic be drilled out before perforating for production the chisel-nosed hydrostatic bailer, which drills the plastic at the rate of about 1 ft. per hr., has been in wide use. Generally recommended for drilling out plastic is the rock bit due to the smoother and easier cutting action. Usually the rock bit is run on the tubing string and the short section filled by plastic drilled out. The rotary method drills the plastic out at the rate of 1 to 5 min. per ft. Tabulated results of plugging through liners and perforated casing are shown in Table 1.

As a true liquid, plastic can be forced into formations at much lower pressures than suspended solids. The injection pressure is slightly higher than that required to inject salt water. Plastic will set up in an oil or gas sand as readily as in a water sand. Usually it is desirable to keep the plastic below the expected productive zone. In some wells a jelflake is used to reduce the permeability of the formation and prevent excessive losses of the plastic. In wells in which the productive zone has been covered by the plastic dumped, it has been drilled out and production established by gun perforating. Laboratory tests show that a bullet fired from a standard 4-in. perforating gun will penetrate 8½ in. into plastic and 8¾ in. into plastic and sand mixtures under

Fig. 1. Right is the log of an East Texas well first completed at 3637 ft. with a liner-screen of 44/100 mesh. The well was plugged back to 3611 ft., drilled out to 3614.5 ft., and 10 holes perforated from 3610-14 ft. Production before plugging was 35 per cent water—after plugging, well produced pipe line oil. Fig. 2. Left is the log of a well in the same survey drilled to 3630 ft. and cemented to 3601 ft. Casing was set at 3611 ft. Plastic, 107 gal., was used to plug the well back to 3595 ft. After drilling out 4 ft., 10 perforations were made from 3590-93 ft. Water production was cut from 50 per cent to 5.8 per cent.





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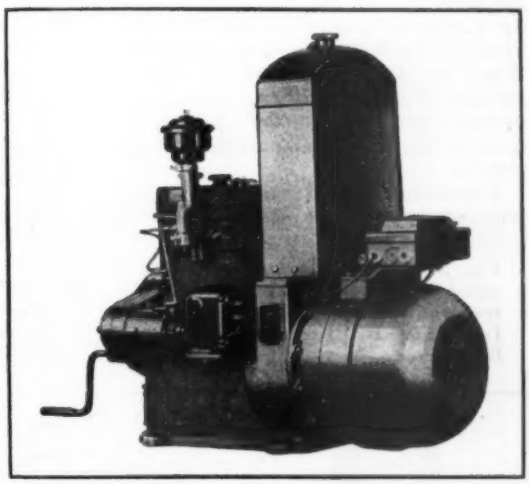

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ELECTRIC PLANTS · PLANNED PLUMBING AND HEATING

TABLE 1

Summary of the plastic results in East Texas field on the last 400 jobs[1]

	No. of wells	Per cent
Open hole only	301 wells treated	
100 per cent water reduction	185	61.5
Satisfactory water reduction	35	11.6
Total of above or satisfactory water reduction	220	73.1
Unsatisfactory water reduction	81	26.9
Open hole under 59 per cent water	195 wells treated	
100 per cent water reduction	164	84.1
Satisfactory water reduction	10	5.2
Total of above or satisfactory water reduction	175	89.3
Unsatisfactory water reduction	21	10.7
Open hole over 59 per cent water	106 wells treated	
100 per cent water reduction	20	18.9
Satisfactory water reduction	26	24.5
Total of above or satisfactory water reduction	46	43.4
Unsatisfactory reduction	60	56.6
Liner and perforated wells only	99 wells treated	
100 per cent water reduction	53	53.5
Satisfactory water reduction	9	9.1
Total of above or satisfactory water reduction	62	62.6
Unsatisfactory water reduction	37	37.4
Liner and perforated wells under 59 per cent water	50 wells treated	
100 per cent water reduction	40	80.0
Satisfactory water reduction	4	8.0
Total of above or satisfactory water reduction	44	88.0
Unsatisfactory water reduction	6	22.0
Liner and perforated wells over 59 per cent water	49 wells treated	
100 per cent water reduction	13	26.5
Satisfactory water reduction	5	10.2
Total of above or satisfactory water reduction	18	36.7
Unsatisfactory water reduction	31	63.3
All wells—open hole, liner and perforated	400 wells treated	
100 per cent water reduction	240	60.0
Satisfactory water reduction	46	11.5
Total of above or satisfactory water reduction	285	71.5
Unsatisfactory water reduction	114	28.5

[1]Data courtesy of Dowell Incorporated.

simulated bottom hole conditions. The tests also showed that a bullet fired from the same gun will penetrate 6½ in. into the plastic or plastic and sand mixture after passing through a ⅜-in. steel plate. When set the plastic has a tensile strength of 240 lb. per sq. in. and a compressive strength of 1900 lb. per sq. in. both of which are comparable to neat cement.

Improvements and changes in the physical properties of plastics have been continuous. One of the major problems faced by operators has been setting temperatures of the plastic. In wells with high temperature, no difficulty has been experienced with setting of the plastic because of temperature, but in wells with low bottom-hole temperatures, some difficulty has been reported. Among the recent developments in plastics for use in wells are those that will set at temperatures ranging from 80° to 280°F. Varying amounts of catalyst also aid in the control of setting time. The high temperature plastic, specific gravity 1.18 or 9.82 lb. per gal., has a viscosity of 850 centipoises at 82°F., whereas the medium temperature plastic developed, specific gravity 1.2 or 9.99 lb. per gal., has a viscosity of 188 centipoises. As a means of comparison the viscosity of SAE No. 40 motor oil is 285 centipoises.

▼ Dump bailer method. Among the more recent advancements in the dump bailer method of placing the plastic in wells is the use of gravel as a filler material. Gravel (¼-in. pea gravel) is especially adaptable in wells in which long sections are to be plugged and in large diameter holes. Filler reduces the amount of plastic required and is therefore economical. When the desired amount of plastic has been dumped on bottom a gravel dumping bailer dumps the gravel into the plastic. Three gallons of plastic are usually sufficient to fill the voids in 10 gal. of gravel without formation loss of plastic. In case of formation loss of plastic, jelflake is used in quantities from ¼ to 1 lb. per 10 gal. of plastic depending on formation permeability and plastic viscosity. The gravel dumping bailer is of special design. It is built in sizes ranging from 3 to 5 in. in diam. and is approximately 22 ft. long. Like the plastic dump bailer the gravel dump bailer is run on a ⅝-in. line. A set of regular 4-in. bailer jars in the bailer is connected to a ⅝-in. rod running the length of the bailer. The bottom end of the bailer is closed by a disk of either plastic or thin metal that is broken when the ⅝-in. rod is driven through it by the jars when the bailer is set on bottom. The end of the rod works through a ¾-in. pipe. Action of the jars causes the rod to break up any gravel tending to bridge and completely dumps the bailer.

Table 1 is a summary of the results obtained on the last 400 wells plugged with plastic by the bailer method in the East Texas field up to July 1. The table compares the results of plastic treatment made in wells having an open hole with those made in wells having liners or screens. It is evident from the table that wells producing under 59 per cent water are better risks for plugging than those producing the higher percentages of water. Data in the table also indicate that in most wells it is not necessary to pull the liner or screen to obtain a good water shutoff with the plastic due to formation penetration and bonding properties of the plastic.

▼ Squeezing with plastic. Squeeze jobs with plastic are still in the early stages of development and as yet no standard squeeze method has been adopted. Methods that have been used to date are virtually the same as those used for cement jobs with the exception that much smaller volumes of plastic are used. This difference has necessitated some changes to handle small volumes. From the data of Table 2 it is evident that the percentage of successful jobs using the squeezing methods is not as high as that of the dump bailer method; however, this difference must be attributed to the type of jobs attempted, as most squeeze jobs are for the purpose of correcting some very difficult problem with small chance

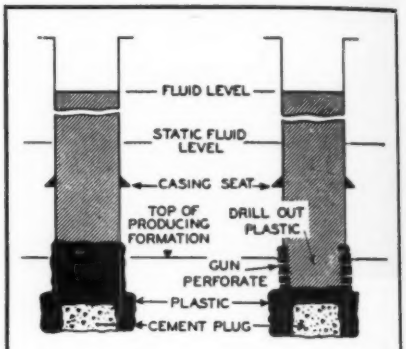
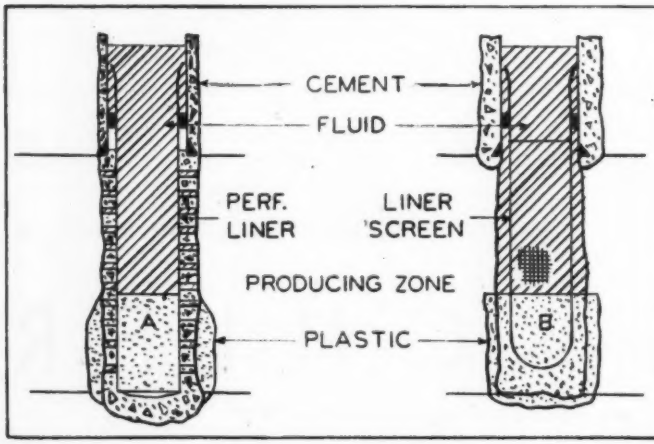


Fig. 4. Example of open hole plugged back with plastic in shallow zone and perforated to obtain production.

Fig. 3. A. Plugback job in perforated liner to eliminate bottom water production through lower perforations. B. Plugback through liner screen.



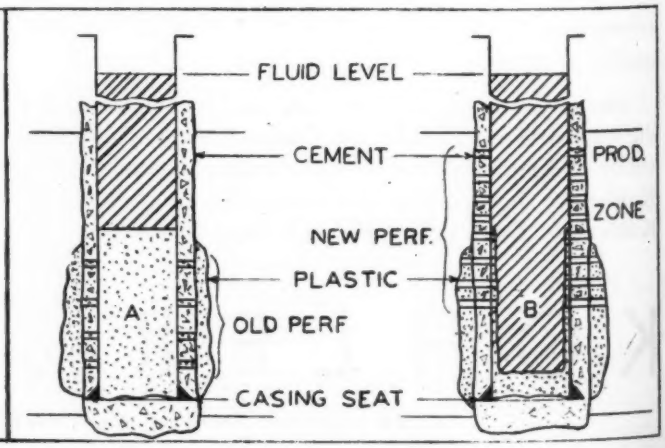


Fig. 5. A. Perforations plugged in bottom of casing with plastic. B. Plastic drilled out to permit upper and center sections to be perforated.

of success, and to equipment and methods.

Equipment used in squeezing with plastic includes two choke nipples that are spaced about 2 ft. apart on the bottom end of the tubing string. In wells equipped with 2-in. tubing the choke nipples are 1 3/16 in. I.D. with tapered throat. The bottom choke is a plain end type whereas the upper choke is designed to serve as a back-pressure valve. A 6-in. rubber plug is run into the tubing before the plastic, then a second plug is used behind the plastic. Thus the volume of plastic can be measured accurately and controlled during the squeeze job as the plastic is between the two rubber plugs. The plugs also prevent contamination of the plastic before it can be placed. Additional pressure over that required to pump the plugs and plastic down the string are required to pump the plugs through the two bottom-hole chokes; therefore a change in pressure indicates that the plugs have reached the chokes on bottom. This indication is important to the operator in employing small volumes of plastic for jobs. Mud in the hole must be displaced above the section to be plugged either by calcium chloride solution or clear water. The two plugs with the desired volume of plastic between them is then pumped down the hole to the choke nipples. When the first choke is encountered by the first plug, the pressure is increased and the plug forced through both nipples. The second plug is pumped through the first nipple, but not through the second as it serves as a back pressure valve to prevent the mud column in the casing from forcing the plastic back up the tubing string. When the tubing has been picked up out of the plastic the second plug is pumped out through the second choke and the rams closed on the tubing. Pressure is then applied to squeeze the plastic from a calibrated tank at the surface for the length of time the plastic takes to set. The outstanding advantage of the bradenhead squeeze lies in the fact that the injection rate can be established by pumping fresh water into the formation as an indicator of the volume of plastic required for the job and the pressure necessary to squeeze the formation with the plastic.

Acknowledgment is made to Dr. John B. Stone of Dowell Incorporated for his courteous cooperation in preparation of this article.

Fig. 6. Plastic squeeze tubing plug landing tool.

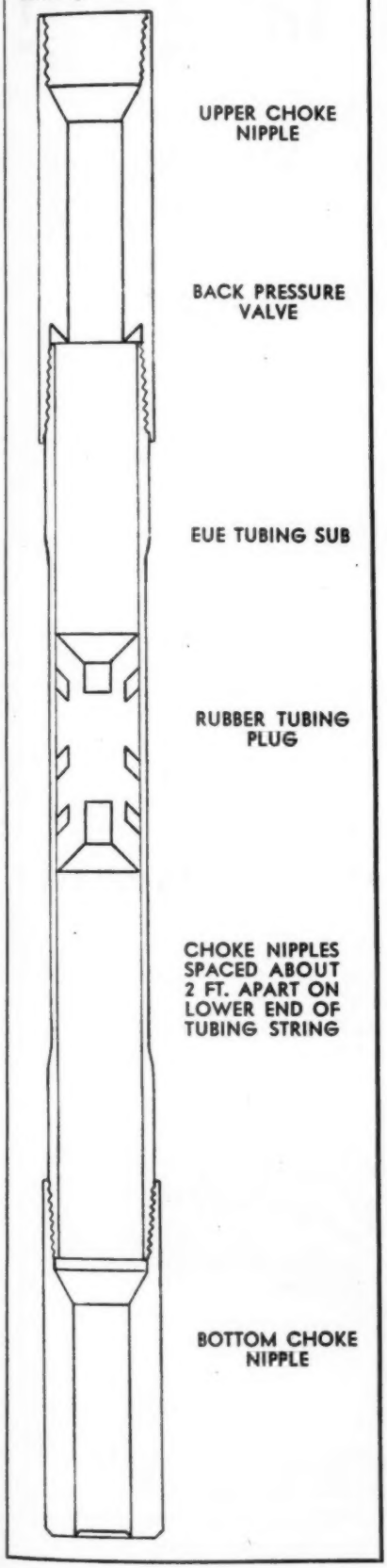

UPPER CHOKE NIPPLE
BACK PRESSURE VALVE
EUE TUBING SUB
RUBBER TUBING PLUG
CHOKE NIPPLES SPACED ABOUT 2 FT. APART ON LOWER END OF TUBING STRING
BOTTOM CHOKE NIPPLE

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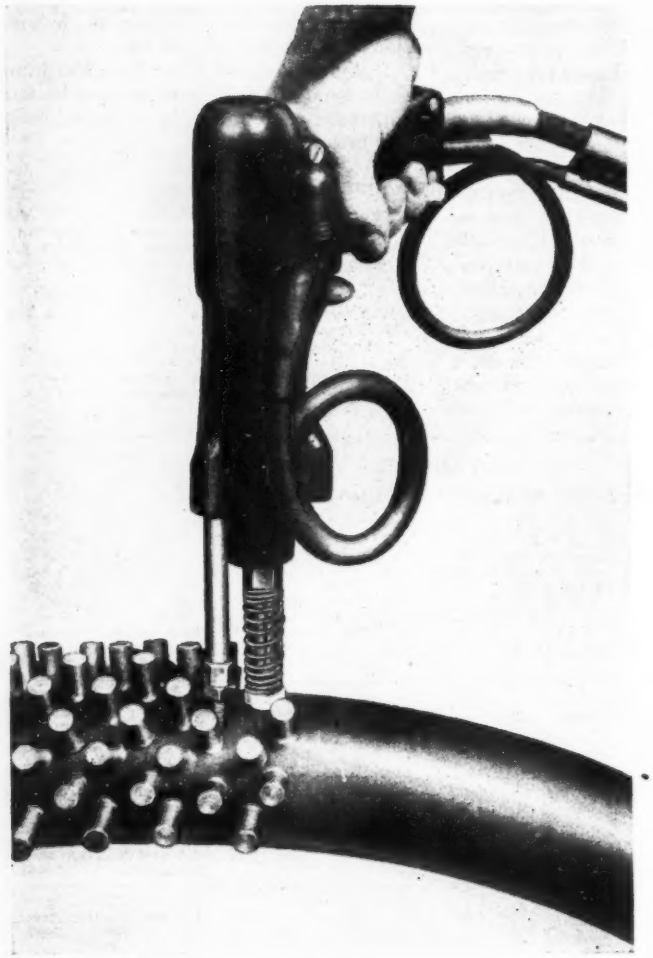
TABLE 2

Tubing type treatments—Plastic squeeze jobs[1]

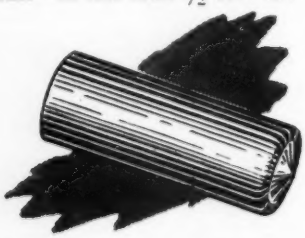
Well No.	Pool or field	Formation treated with plastic	Bottom hole temperature, °F.	Gal. Plastic	Production, per cent				Remarks
					Before		After		
					Water	Oil	Water	Oil	
1	Hawkins pool	Woodbine	160	100	85	15	85	15	Squeesed off 2-ft. perforated section of the casing. Unsuccessful.
2	Carthage pool, Panola, Texas	Rodessa	190	50	100	0	0	0	Successfully squeesed off 8 ft. of perforations in casing. Will drill out and reperforate deeper—100 per cent water shut off.
3	Carthage pool, Panola, Texas	Rodessa	190	50	90	10	0	100	Squeesed off 16 ft. of old perforations — 100 per cent water shut off.
4	Carthage Pool, Panola, Texas	Rodessa	200	100	100	..	100	..	Squeesed off 16 ft. of new perforations.
5	Magnolia pool, Columbia County, Arkansas	Smackover lime	235	50	85	15	30	70	Squeezed off 4 ft. of perforations in casing. Operator to perforate and test higher. Partial water shut off.
6	Winnsboro pool, Franklin County, Texas	Pettit lime	220	40	30	70	0	100	Repair cement job by squeezing plastic through 1 ft. of perforated section of the casing. Operator drilled out and perforated well flowing pipe line oil. 100 per cent water shut off.
7	Converse, Sabine Parish, Louisiana	Blossom sand	206	75	99	1	99	..	Squeesed off top 4 ft. of perforations and bottom perforated section leaving 20 ft. in the middle.
8	Long Lake, Anderson County, Texas	Woodbine	170	....	100	0	0	100	Squeesed off 2 ft. of open hole below casing. Operator perforated casing above plastic.
9	Cayuga, Anderson County, Texas	Woodbine sand	160	50	98	2	0	100	Squeesed off 2 ft. of perforated casing. Operator gun perforated higher.
10	Opelika, Henderson County, Texas	Pettit and Travis	260	200	..	..	..	..	Successfully squeesed off communication between the Pettit and Travis formation behind the casing. Operator to produce from bottom section and inject gas in upper section.

[1]Data courtesy of Dowell Incorporated.

End-weld studs automatically for boiler repair and lagging!



Studs are welded 1¼" apart on 19° centers. The studs are placed in the chuck of the gun, a porcelain ferrule placed on, and the trigger pulled. An arc is created which automatically welds the stud. Complete fusion of the stud to tube is the result—*in less than ½ second!*



This is the stud used on the boiler tubes. It is a Nelson "Flux-filled" ½" diameter stud. These studs are manufactured in many diameters and lengths.

The Nelson Stud Welder automatically end-welds in less than ½ second!

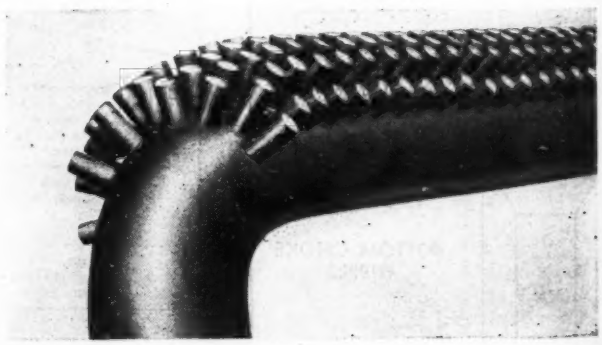
The Nelson Stud Welder is a tried and proven welding tool. Proven by five years actual usage it is today used in more than 400 industrial plants. It is the one means of automatically end-welding studs to metal *right in your own plant.*

Here are typical examples of time and material saved by its use. Two women welders recently welded 13,000 studs on boiler tubes in 18 hours. One welder and helper studded an average of 24 feet or 2300 studs in 8 hours. These are not special tests but checks made on regular jobs.

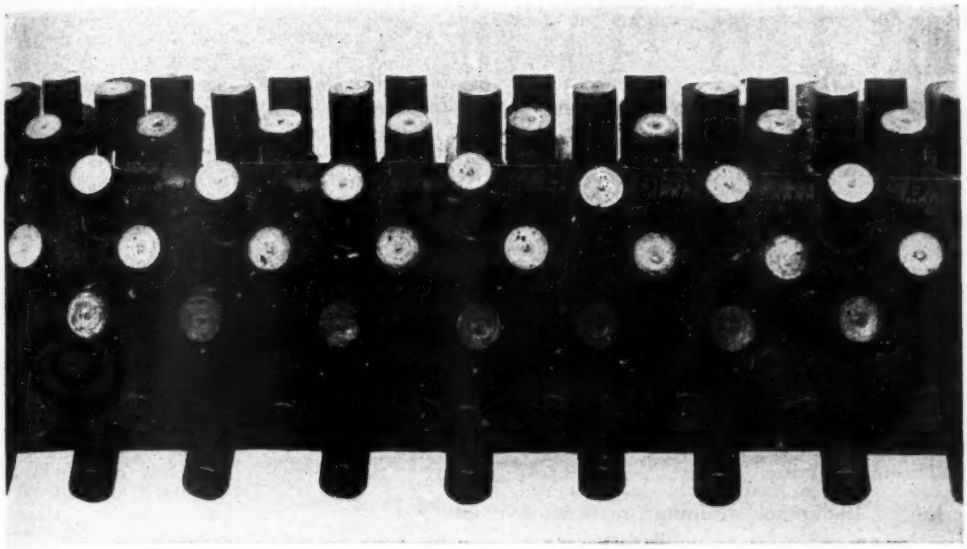
For boiler maintenance or lagging of tanks, storage bins, etc., this stud welder will answer your problems. Excellent for general maintenance, too. It is completely portable and may be easily operated by anyone. *No experience necessary!*

FREE CATALOG & SAMPLES!

Complete information about how you can use the Nelson Stud Welder in your refinery is available to you at no obligation. Simply address a letter to us and we will send you complete details. Address your request for information to:

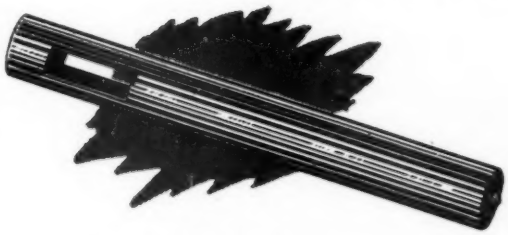


Complete fusion results from the timing and full shielding of the arc. The strength of the weld is stronger than the strength of the steel of the stud. No previous welding experience necessary to do welding of this type.



Close-up view shows alignment of the studs on the tubes. The uniformity of the weld gives satisfactory results and a strong, easily accomplished job.

LAGGING MAGNESIA BLOCKS

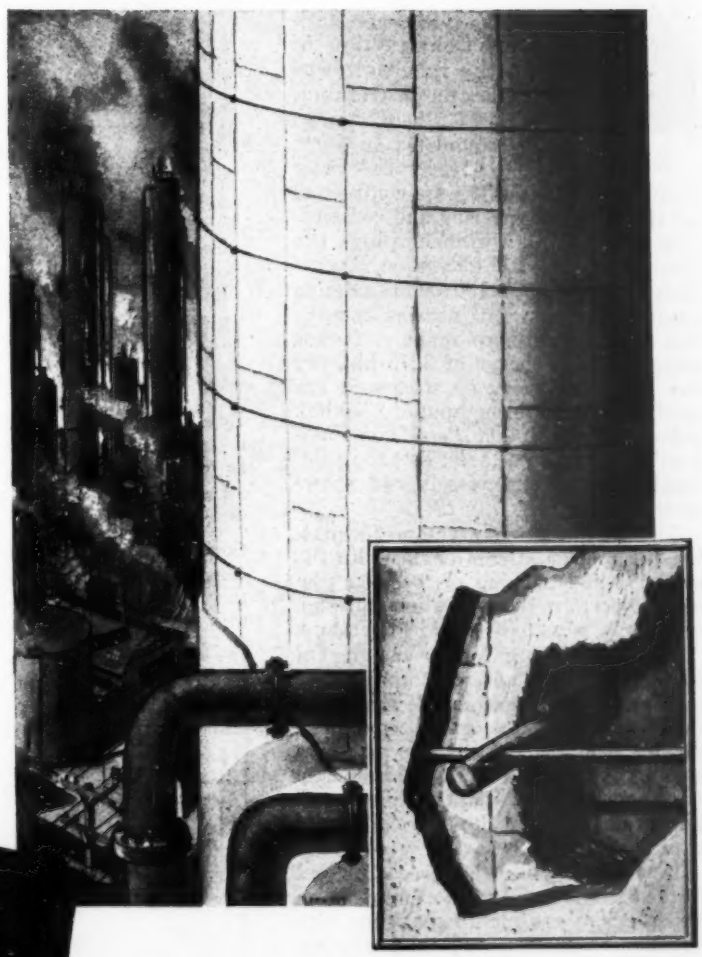


The Nelson Lagging Stud has been especially developed for securing magnesia blocks to heat exchangers, storage bins, tanks, etc. Rapidly welded into position they hold the blocks securely to the metal. Plastered over, the heads act as reinforcing. To save both time and material in this important operation use the Nelson Lagging Stud. *Write today for complete information to:*

NELSON SPECIALTY WELDING EQUIPMENT CORP.

Dept. 42, 440 Peralta Avenue, San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 South Sixth St., Camden, N. J.



NELSON STUD WELDERS

The studs are welded in rows to the tower. Wire is run through the slots and left slack. The magnesia blocks are slipped under into position and the wire tightened down to secure them. The entire unit is then covered with plaster to complete the work.

HF ALKYLATION UNIT PLACED ON STREAM IN RECORD TIME

By JOHN H. KUNKEL, *Refinery Editor*

EXCLUSIVE D-DAY and H-hour for the new HF alkylation unit recently completed for the Socony-Vacuum Oil Company, Inc., at Paulsboro, New Jersey, was June 16, 1944, at 5 o'clock in the afternoon when the unit, which is the first of its particular design, was ready to be placed on stream. So careful was the planning, and so thorough were the preparations, that light alkylate was being produced by midnight, or in the remarkable record-making elapsed time of but 7 hours after the unit was initially charged with B-B feed stock.

John H. Kunkel

Construction of the new unit was begun in October, 1943, and it was completed in June, 1944, by The Fluor Corporation, Ltd., who were contractors for the unit's engineering and construction. The plant, which employs the Socony-Vacuum HF alkylation process design, is part of an 100-octane aviation gasoline program now nearing completion in the Paulsboro refinery. It was designed for a charge of 2275 bbl. per day but, since going on stream, it has easily handled a throughput of 2800 bbl. per day. Table 1, *The Petroleum Engineer's* column data table, lists the principal columns and vessels and shows their dimensions.

The story of the preparations for placing the unit on stream begins with the selection and training of the men who were to perform that operation and who, ultimately, were to become its operators.

It is the policy of Socony-Vacuum Oil Company, Inc., to advertise new refinery jobs among its employees so that those qualified and eligible may become candidates. The men selected are placed in a Job Instruction Training class where they receive intensive training in all phases of their new duties from men of experience.

In this instance, the procedure led to the selection of 4 men, each of whom had previous gas plant experience with Socony. These men and their new assignments were: W. A. Budd, assistant foreman; T. Greenwood, T. Zedalis, and A. Paff, No. 1 operators, and J. Fletcher, breaker between No. 1 and No. 2 operators.

With their previous gas plant experience as a background, these men began their training period. Classroom instruction covered such subjects as the theory of the HF alkylation process, the basic fundamentals of the chemical reactions involved, the characteristics of anhydrous hydrofluoric acid, its effect on equipment, methods of handling the acid, and the safety practices involved.

Socony-Vacuum has an HF alkylation plant in its Augusta, Kansas, refinery. The 4 men visited Augusta and, in a 10-day field training program, observed HF alkylation plant operating procedures, techniques, and practices. At the conclusion of this period, they visited the Socony-Vacuum refinery at East St. Louis where an HF alkylation unit was ready to go on stream and there they studied the techniques of that operation.

EDITOR'S NOTE

The new Socony-Vacuum HF alkylation unit at Paulsboro, New Jersey, was placed on stream in record time. In the belief that many of our readers will be interested in the operations necessary to place a refinery unit on stream, this article has been written to describe not only the unit's process flow but the break-in run preparations that made the record on stream time of seven hours possible to achieve.

By this time, the Paulsboro unit was nearing completion and they returned to prepare the plant for placing on stream.

▼ **Evacuation system.** In actual operation, the unit is charged with B-B (butane-butylene) feed stock, which passes through a salt dryer and the dehydrators after which it joins a stream of isobutane before entering the contactor. To prepare the unit to go on stream, however, it was given a break-in run with isobutane as the charge. This break-in run started June 11 and continued until June 16 for the purpose of getting the instruments on control, to check the system for leaks and to set up the entire unit for smooth operation.

Before starting this break-in run and charging the unit with isobutane, air was evacuated from all vessels and columns to eliminate possibility of hydrocarbon and air combining to form an explosive mixture. The evacuation system, which is a part of the unit, is normally used to evacuate the acid section only, but it is so designed that it can be used to evacuate the entire unit.

This system consists of a horizontal caustic surge tank, centrifugal pumps, a vertical evacuation column, steam ejectors, and an evacuation stack.

The caustic surge tank, through the base of which passes a high pressure steam line, is half-filled with sodium hydroxide, 11 Bé gravity. Hot caustic is pumped from the base of the surge tank by a centrifugal pump to the top of the evacuation column and, from its bottom, back to the surge tank and recycled through the system.

The evacuation column contains a series of baffles. An air line, from the unit to be evacuated, enters the base of the evacuation column and the evacuated air rises countercurrent to the caustic, passes out overhead to the top of the surge tank and, overheard from the surge tank, to the ejectors. Steam, at a pressure of 165 lb. per sq. in. gauge*, passes through the ejectors to the stack. The suction so set up evacuates the air from the HF alkylation unit's columns and vessels, and in so doing, establishes the vacuum.

▼ **Start of the break-in run.** The unit's feed storage system consists of 2 B-B spheres each of which has a capacity of 2100 bbl. and 1 isobutane recycle sphere of similar capacity. In actual operation, B-B is charged to the unit, but in the break-in run, both B-B spheres were filled with isobutane, and the iso-

*Unless otherwise stated, all pressures are in pounds per square inch, gauge.

TABLE 1

***The Petroleum Engineer's* column data table**

	Acid stripper	Acid regenerator	Deiso-butanizer	Debutanizer	Alkylate rerun
Height, ft.	61	17	127	87	55
I. D., in.	48	42	108	48	48
Design press. (lb. per sq. in. ga.)	258	191	150	170	113
Design temp. bottom, °F	200	375	210	340	375
Design temp. top, °F	154	265	130	130	225
Piping sizes, in.:					
Inlet	4	4	6	6	3
Overhead	3	4	18	6	8
Bottom	4	2	4	3	2
Trays*:					
Number	21	(a)	50	30	16
Spacing, in.	24	..	24	24	24
Inlet tray number†	1	(b)	18–24–30	7–11–15	6
Input capacity, lb. per hr.	50,195	2,940	38,332	15,020	10,100
X-rayed	yes	yes	yes	no	no
Stress relieved	yes	yes	yes	no	no

(a) Acid regenerator flash tank contains 2 sections each containing 5 segmented baffles.

(b) Feed to acid regenerator is over top baffle in upper section.

*All trays are welded steel type, 3/16-in. thick. Caps are 1/8-in. thick, pressed in one operation and stress-relieved. All trays and caps are Fluor design.

†All trays are numbered from top to bottom.

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butane sphere was half-filled with isoC4 and the entire unit was operated on isobutane prior to going on stream with B-B charge. Table 2 shows a typical analysis of the B-B charge stock and a typical analysis of the isobutane recycle stock.

In this installation all light hydrocarbon pumps are provided with mechanical seals. Seal oil was put on the 2 B-B charge pumps before the break-in run was started. Each of these pumps is rated at 20 hp. at 3550 r.p.m. and each discharges at the rate of 98 gal. per min. To take the charge, the B-B line valve to the salt drier was opened as was this tank's 3-in. outlet line valve. This tank is designed for a pressure of 247 lb. It is filled with common rock salt. Its function, in the alkylation process, is to remove all free moisture from the B-B charge, the charge coming in at the top, the salt water being discarded to sewage off the bottom.

▼ **Dehydrators.** There are 4 dehydrators, 3 of which are process dehydrators and 1 a gas-pressuring dehydrator. This latter column contains driocel (alumina earth) and its function is to dehydrate gas used to transfer acid from storage to the unit and acid-hydrocarbon mixtures from the acid operating section by the blow-case method.

The process dehydrators are designed for a pressure of 269 lb. Each is filled with driocel. As regeneration of each dehydrators occurs once every 8 hours, they are in parallel so that 2 can remain on stream while the third is regenerating. A portion of the charge from the salt drier is passed through a hydrocarbon heater that employs steam at a pressure of 400 lb. The superheater vapors pass into the dehydrator, effecting regeneration.

Flow through the on stream dehydrators is from overhead to bottom.

TABLE 2

Typical analysis of charge stock

Isobutane	44.0
Isobutene	9.8
Butene 1	9.4
Butene 2	13.5
N-butane	17.7
Pentane	5.6
	100.00

Typical analysis of isobutane recycle stock

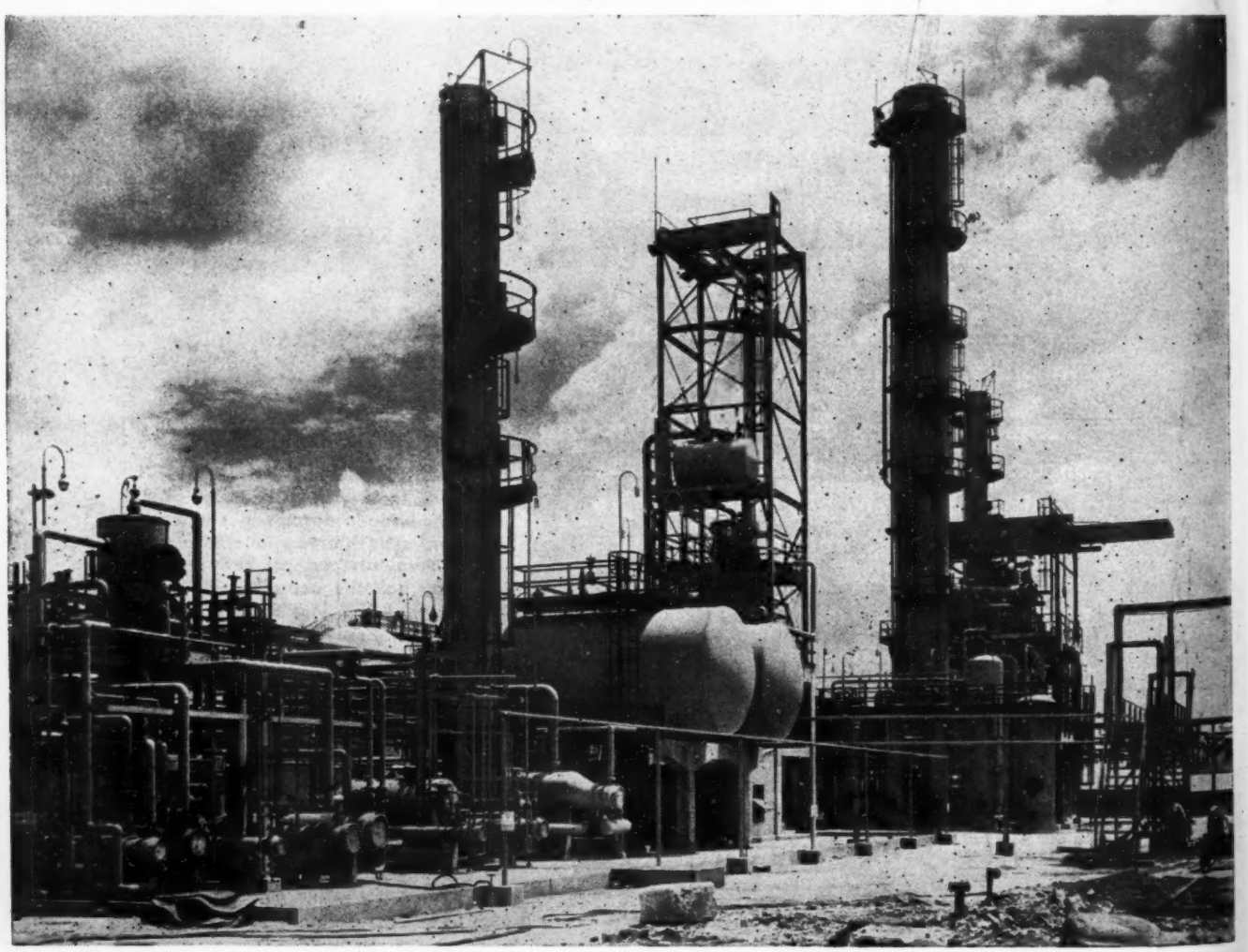
Propane	9.4
Isobutane	82.6
N-butane	8.0
	100.00

▼ **Preparing the dehydrators.** In preparing the dehydrators for the break-in run, the operator opened the inlet to the hydrocarbon heater and then opened its outlet. The B-B outlet valves at the base of No. 1, 2, and 3 process dehydrators were closed and the regenerator inlet on the gas-pressuring dehydrator was opened. The regenerator outlet on the gas-pressuring dehydrator was also opened.

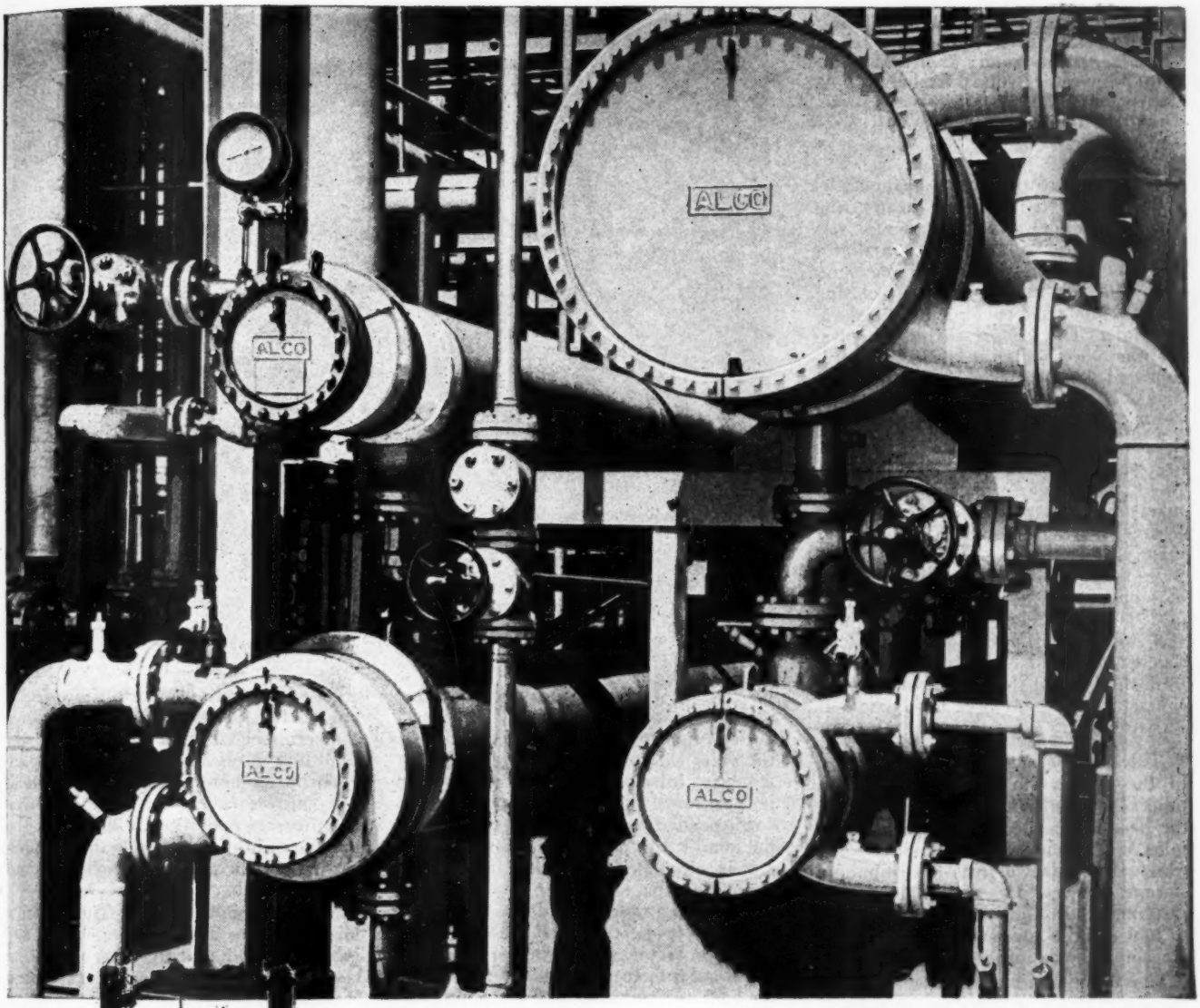
In the regeneration process, hydrocarbon vapors pass off overhead from the dehydrators and these are returned through a water-cooled hydrocarbon condenser to the B-B spheres. At this point the inlet to, and the outlet from, the hydrocarbon condenser were opened, after which a full head of water was placed on the condenser.

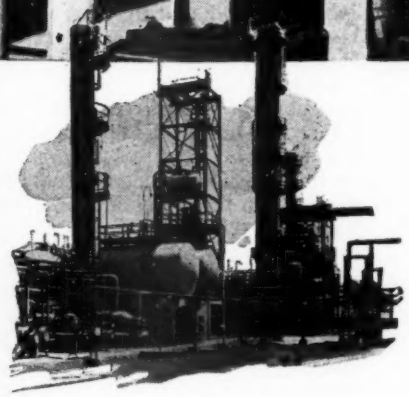
Now the unit was ready to receive its isobutane break-in charge as far as the dehydrators. The B-B charge pump suction valve was opened and the pump vented to 0 lb. This was evidenced by the appearance of liquid at the vent at which time the B-B charge pump was started and the pump discharge valve was cracked open to permit the break-in charge to enter and pass through the salt drier. All lines were now carefully checked for leaks.

The rise of inlet pressure to the hydrocarbon condenser was carefully noted and when the pressure built up to a minimum of 50 lb. the regenerator return to the B-B storage spheres was opened.



General view of HF alkylation unit. Left to right, acid stripper, acid settler tank, acid surge tank, contactor, dehydrators and salt drier, debutanizer and deisobutanizer at Paulsboro.





59 ALCO Heat Exchangers in H-F Alkylation Unit at Socony-Vacuum's Paulsboro Plant

As advanced technique crystallizes in new refinery processes and units, designers of component equipment must keep step. The ALCO Products Division of American Locomotive Company has the engineering organization, the manufacturing facilities, needed to design and produce heat exchangers adapted to meet any requirement, however new, and of any magnitude.

An example is ALCO'S fast handling of design and construction of 59 heat exchangers for the H-F alkylation unit in Socony-Vacuum's 100-octane aviation gasoline plant at Paulsboro, New Jersey. Quick delivery, often a crucial factor, was a high spot in this job. ALCO got off the mark in a hurry and rushed the delivery through in extremely fast time, especially considering war conditions.

Whether a job calls for heat exchangers, prefabricated piping, or pressure vessels, ALCO engineers and shops can handle efficiently any emergency or routine order, large or small.

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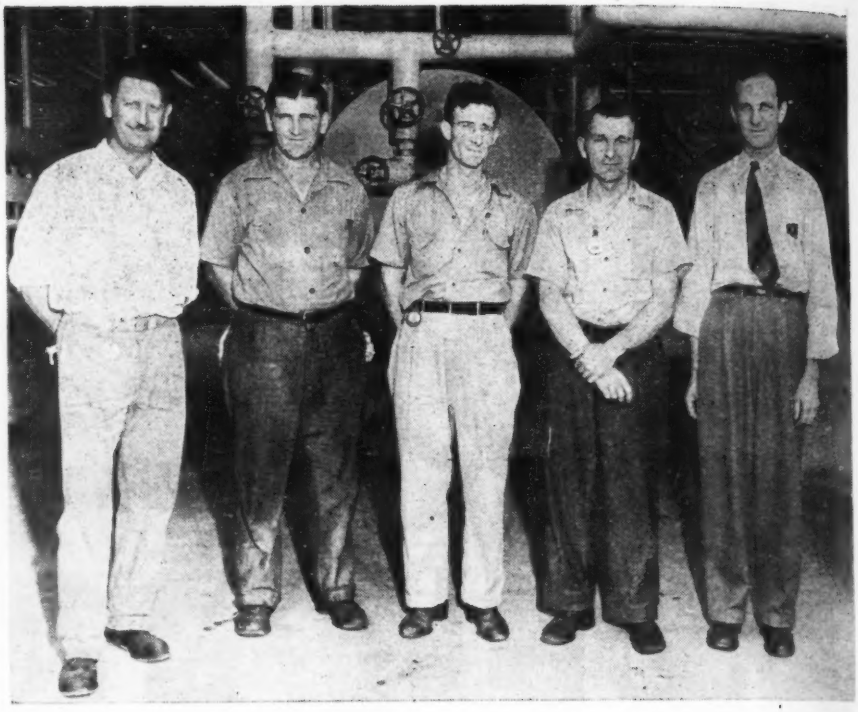


Plant operators, left to right: Thomas Barrett, No. 2 operator; John Bender, utility man; James Hogan, No. 3 operator; John Fletcher, No. 1 operator; W. A. Budd, assistant foreman, at the New Jersey plant.

An operator opened the steam outlet valve on the hydrocarbon heater and the steam inlet valve to the heater was cracked open. No. 1 process dehydrator was now ready for its initial regeneration. This was accomplished by closing its B-B inlet and opening its regeneration inlet. The gas-pressuring dehydrator was closed off to permit this operation and No. 1 process dehydrator was regenerated as quickly as possible.

When the outlet temperature of No. 1 dehydrator reached 350° F. the procedure was as follows: The B-B inlet to No. 2 dehydrator was closed and the regenerator inlet and outlet opened to permit regeneration. The regenerator inlet and outlet to No. 1 dehydrator were closed. The B-B inlet to No. 1 was now opened to receive charge and permitted to fill. When No. 2 dehydrator was regenerated, No. 3 was placed on regeneration and No. 2 filled. The flow from the base of the dehydrators to the contactor was kept closed until that unit was prepared.

▼ **The contactor; its function and flow.** In the Socony-Vacuum HF alkylation process design, the flow of B-B from the base of the dehydrators meets and joins a stream of isobutane recycle, which is withdrawn from the isobutane storage spheres. The recycle isobutane is pumped through centrifugal pumps to join the B-B stream upstream of the HF contactor to form a composite feed.

The function of the contactor is to cause a reaction of isobutane with butylenes to form isooctanes with HF acid as the catalyst. Vigorous agitation is required to create an intimate mixture of the hydrocarbons and acid. The reaction is exothermic, and high-level refrigeration is employed as a means of cooling the reacting liquids.

The HF contactor is 21 ft. 6 in. by 8 ft. I.D. It is designed for a pressure of 160 lb. It has 2 composite feed inlets near its base, 1 entering at each side; an HF acid inlet near its top; an effluent outlet opposite the acid inlet, and on the tube side there is an overhead refrigerant inlet with the refrigerant outlet positioned just below.

Suspended inside is a refrigerant tube fin bundle through which the refrigerant is circulated. The tube bundle is a double pipe exchanger in which the liquid refrigerant flows down the inner pipe, is vaporized by the reaction heat in the contactor, and the vapor flows up the annular space and out of the contactor back to the refrigeration system. An agitator, driven through a gear reducer by a 250-hp., 450-r.p.m. high-pressure steam turbine, is installed in the base of the contactor.

The composite feed enters the contactor and meets the incoming HF acid. The agitator intimately mixes the hydrocarbons and acid and forces the mixture to flow between the refrigerant tubes for dissipation of the heat of reaction.

Table 3 shows the composition of the typical charge to the contactor. Table 4 is a typical analysis of the hydrofluoric acid.

The refrigeration cycle operates as a closed system. Liquid butane flows from the bottom of a vertical refrigerant accumulator to an aftercooler and thence to a vertical heavy-end drop out chamber. From this, the flow is to a horizontal refrigerant evaporator that is constantly held at a liquid level of about 4 ft. By gravity, the flow of the liquid then is into and down the inner tube of the contactor tube bundle. This high level of refrigeration results in a 27.5 mean temperature difference between the refrigerant in the tubes and the hydrocarbon mixture.

Vaporized butane leaves the contactor tube bundle and is returned to the top of the refrigerant evaporator from whence it is withdrawn to the refrigerant suction scrubber. The vapor from the scrubber enters a steam jacket suction line preheater to effect complete vaporization before entering a battery of 3 compressors. These are rotary-type compressors operating at 870 r.p.m. The maximum inlet pressure to the compressors is 43 lb. and the discharge pressure is 117 lb.

Vapors from the compressors enter a mist extractor for the removal of any lubricating oil that may have been entrained in passing through the compressors. The vapors then pass to a water-cooled condenser and thence, as liquid, are returned to the refrigerant accumulator. A portion of the vapors bypass the condenser on pressure control and on entering the accumulator hold a pressure on the vessel sufficient to force the liquid refrigerant to the refrigerant evaporator.

▼ **Acid cycle.** Effluent—consisting of propane, isobutane, n-butane, light and heavy alkylate, HF acid, tar, and a small amount of water—from the contactor enters a combined acid settler and surge tank. This horizontal vessel is designed for a pressure of 153 lb. A novel feature of its design is an open, submerged cone attached to the end of the inlet nozzle that carries the contactor effluent to the bottom of the settler at the opposite end from suction, the deacceleration so effected enabling more efficient separation of acid from the acid-hydrocarbon mixture.

HF acid is pumped from the base of the settler back to the contactor. Acid, at the rate of 2940 lb. per hr., is bled off ahead of the contactor, passes through a preheater employing 400-lb. steam, and goes to the acid regenerator flash tower.

The acid regenerator is a vertical vessel designed for a pressure of 191 lb.

TABLE 3
Typical charge to contactor

Propane	6.06
Isobutane	69.40
N-butane	12.18
Pentane	1.26
Total olefin	11.10
	100.00
Acid circulation	6100 bbl. per day
Lt. alkylate to olefin ratio	1.96
Isobutane to olefin ratio	6.15
Vol. alkylate to isobutane consumed	1.08

TABLE 4
Typical analysis of hydrofluoric acid

Per cent by weight HF acid	91.00
Weight per cent of tar	0.65
Water	2.00
Soluble oil	6.35
	100.00

The column contains 2 sections and has 5 segmented baffles in the top and 5 similar baffles in the bottom. Isobutane from storage that passes through a preheater employing 400-lb. steam, enters the base and is used to strip tar from the acid. Tar passes out the bottom, is cooled, and goes to fuel oil storage.

Regenerated acid passes overhead from the regenerator, through an overhead water-cooled condenser, and returns to the acid settler.

The acid settler serves as a settler and acid stripper feed surge tank. Acid from the bottom of the settler is returned to the contactor. From the upper hydrocarbon layer a pump takes suction to feed the acid stripper. A vapor space is maintained in the top of the vessel. Feed is pumped to the top, or first tray*, of the acid stripper. The acid stripper is designed for a pressure of 258 lb. It is equipped with a kettle-type steam reboiler, an accumulator, an exchange-type overhead condenser, and an aftercooler.

Acid and hydrocarbons, overhead from the stripper, pass through a vapor back-pressure valve and the overhead condenser to the accumulator, through the aftercooler, and back to the acid settler. Bottoms pass to the deisobutanizer.

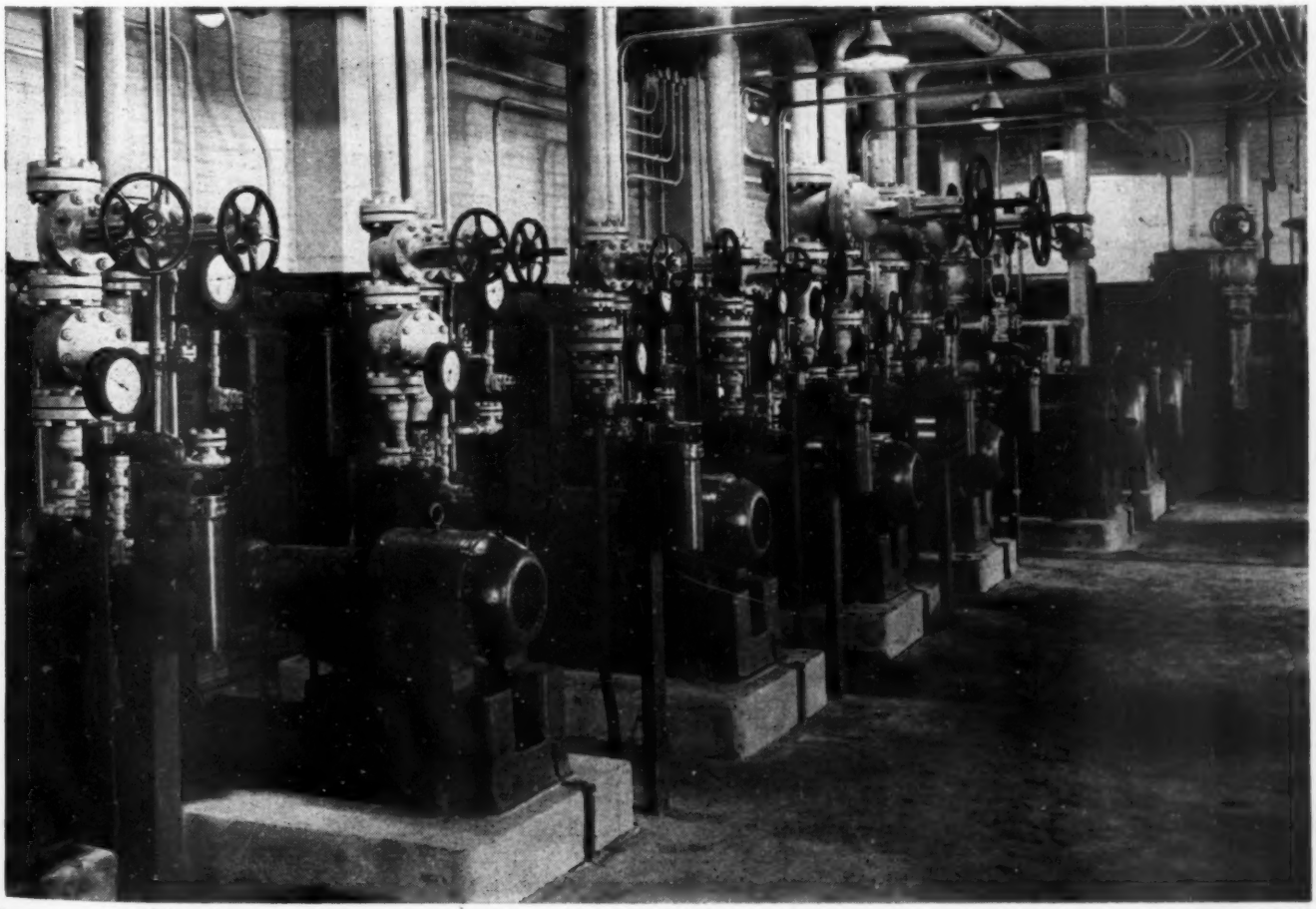
The stripper reboiler employs 45-lb. steam obtained from the 250-hp. turbine in the contactor, which uses 165-lb. steam, the turbine acting as a reducing valve. Steam at 45 lb. from this source also serves the deisobutanizer twin vertical reboilers.

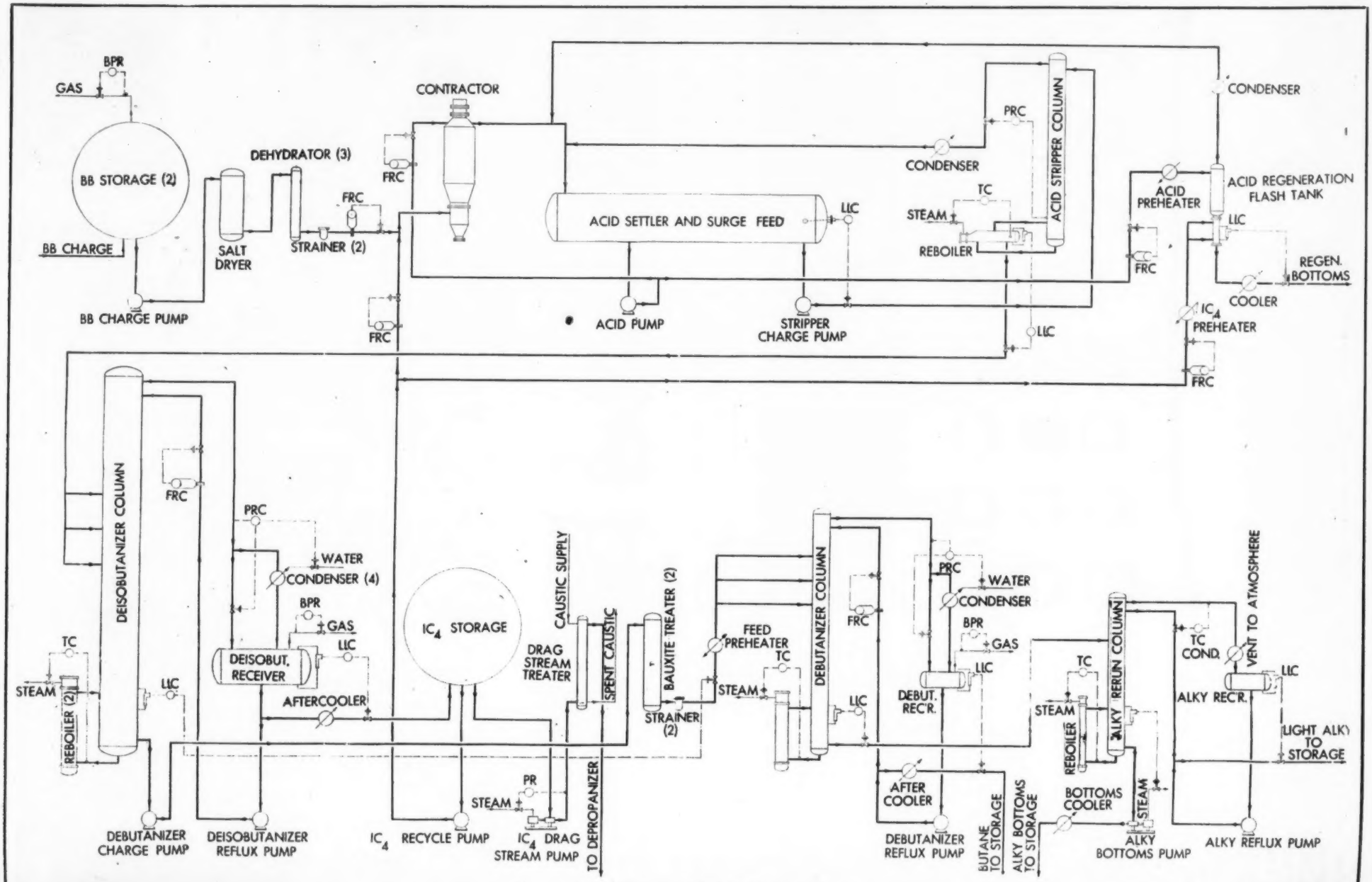
*All trays are numbered from top to bottom.

View of instrument panel.

▼ **Preparing the contactor to go on stream.** In readying the contactor for the break-in run, the evacuation cock on the contactor hydrocarbon inlet was closed

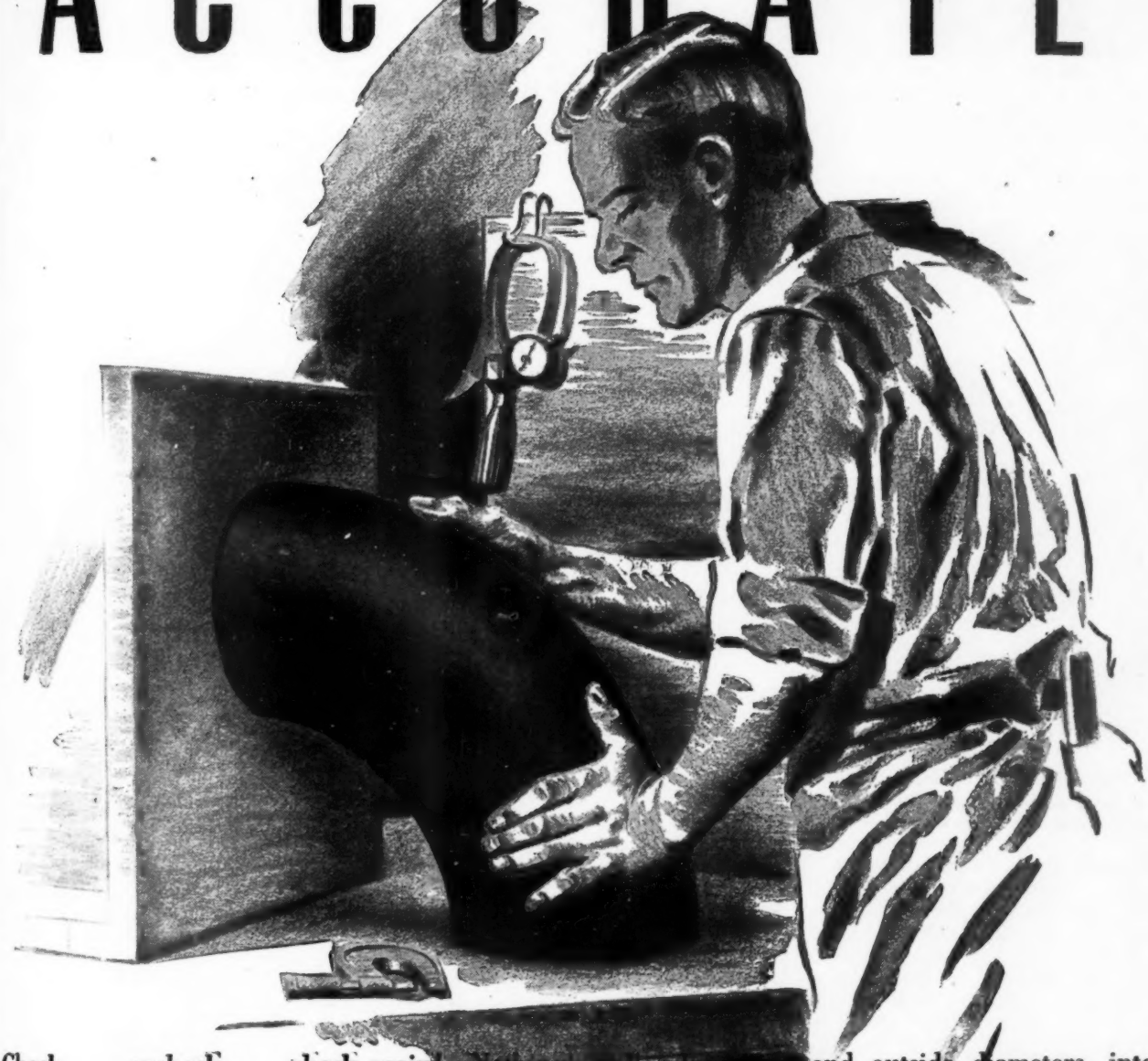
Pumps and motors in plant.





Process flow diagram of HF alkylation plant.

ACCURATE



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as were both contactor hydrocarbon inlet cocks. The flow regulator on the B-B feed line to the contactor was opened.

There are 2 strainers on the B-B feed line to the contactor. These serve to remove any bauxite fines from the dehydrators. One of the strainers was opened and the other closed. The isobutane recycle valves were closed at the flow regulator to prevent flow of isobutane recycle.

The seal oil set supplying seal oil to the contactor duraseal pump was started and checked for proper functioning. The contactor effluent outlet line to the acid settler was opened and the cock to the settler from the acid regenerator was closed to prevent backflow to the regenerator. Similarly, the cock from the HF stripper tower was closed to prevent backflow into the stripper.

The acid settler inlet cock was opened. The cock from the bottom of the settler to the acid charge pumps was closed. To prevent loss to the evacuation system, the evacuation cock on the acid settler was closed. The acid charge cock at the bottom of the settler was closed to prevent outflow. The cock on the side of the acid settler to the HF acid stripper charge pumps was closed.

The hydrocarbon inlet cocks on the contactor were cracked open gradually to permit flow into the contactor and, with the effluent line open to the acid settler and from the acid settler to the surge tank, and with all bottom lines on these vessels closed, hydrocarbon was admitted into these vessels. The operator observed the level in the settler and when it was half full the contactor hydrocarbon inlet cocks were closed until the acid stripper was prepared.

▼ **Preparing the acid stripper.** To ready the acid stripper, it was necessary to bring it up to its operating temperature and pressure. This was done by closing the bottoms valve on the outlet of the stripper reboiler to prevent flow to the deisobutanizer. A special line from isobutane recycle storage to the acid stripper was provided to charge the column for the break-in run as well as for all start-ups. This line was opened. The line to the base of the acid regenerator flash tank was closed as in the break-in run, acid regeneration was not necessary. The bottoms valve on the stripper reboiler outlet was opened and the evacuation cock on the HF stripper closed. The reboiler line into the stripper was opened.

The water system in the unit's acid area is a closed system separate from the refinery's main cooling water supply. Any contamination is thus confined within this system, eliminating all possibility of acid entering the main refinery cooling water supply.

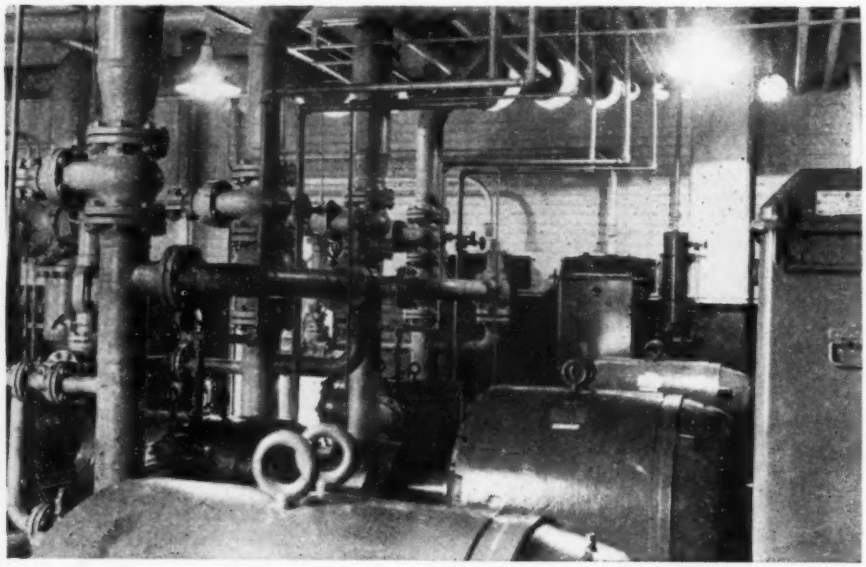
The water circulating system was opened to permit flow through the stripper overhead condenser and the aftercooler. Steam at a pressure of 45 lb. was introduced into the stripper reboiler, the stripper feed pumps started and

TABLE 5
Typical alkylate tests

	Light alkylate	Heavy alkylate
API gravity	72.6	50.03
Color (Saybolt)	30.0+	....
ASTM distillation I.P.	138°F.	386°F.
5 per cent	....	392°
10 per cent	180°	394°
30 per cent	210°	....
50 per cent	218°	415°
90 per cent	234°	478°
99 per cent (E.P.)	349°	542°
R.V.P.	3.1	....
Octane (1c clear)	92.4	....
1c+4.6 ccs of TEL	108.7	....
Copper dish corrosion	excellent	....
Accelerated gum	1.6	....

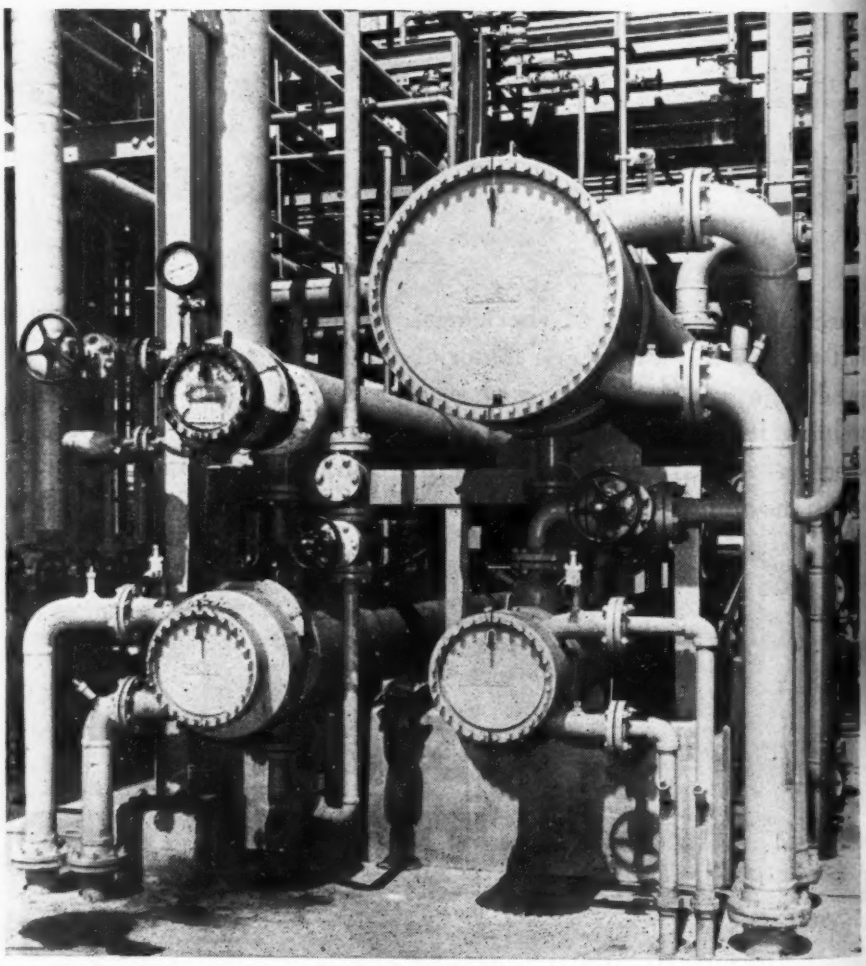
POD analysis of light alkylate

Isopentane	10.7
N-pentane	0.4
C_6+	88.9
	100.00



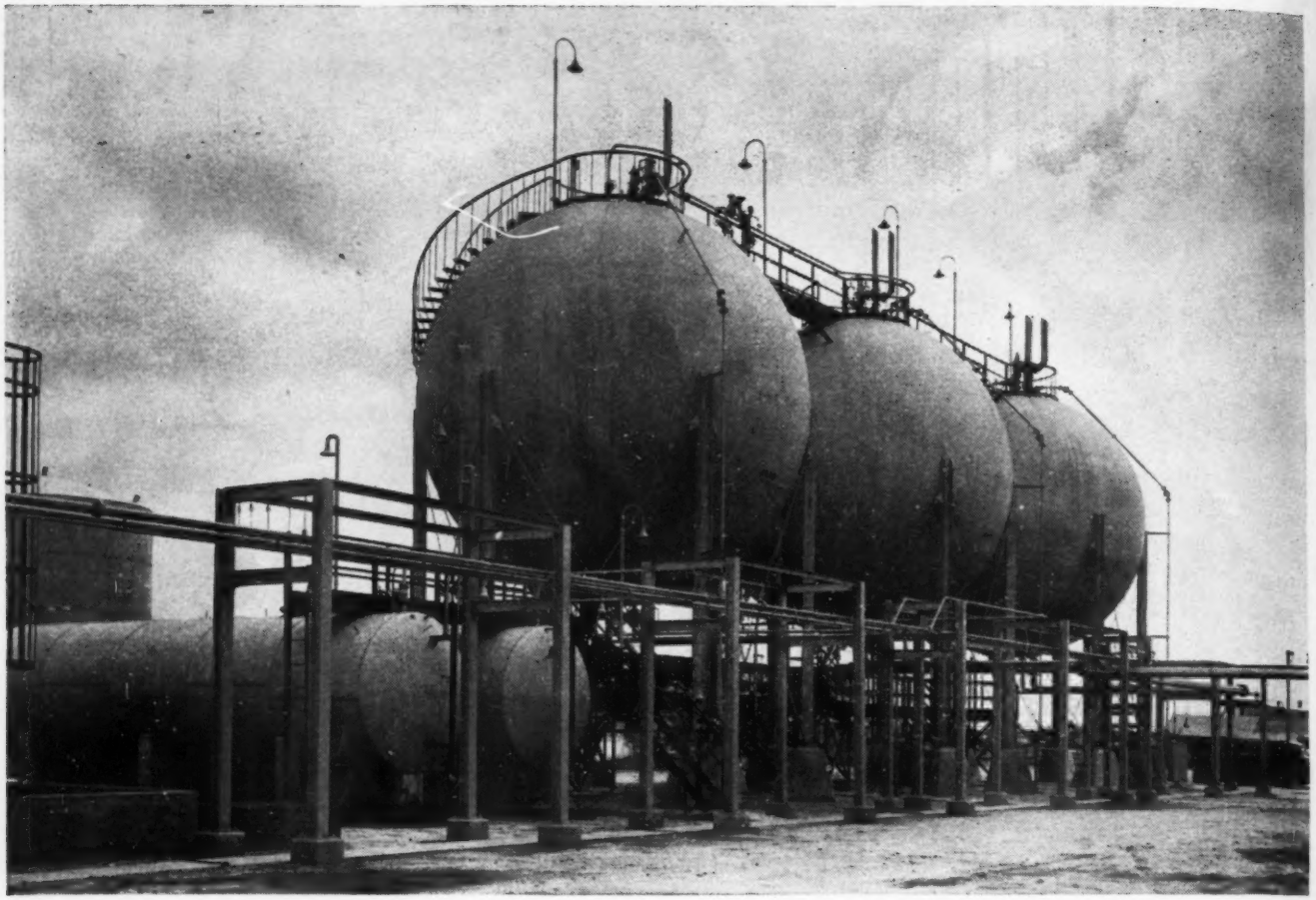
Rotary compressors and motors.

Condensers.



● **Fabricating a 12-foot hemispherical head for pressure storage tank . . . .**

Wyatt's



B-B isobutane storage tank installation.

the isoC$_4$ start-up feed charged into the stripper. The operator observed the level in the reboiler and the level in the stripper accumulator. When normal level in the accumulator was reached, the cock to the acid settler from the accumulator was opened, thus completing the start-up cycle in the acid section.

▼ **Preparing the refrigeration system.** B-B is the refrigerant used to cool reacting liquids in the contactor. To prepare this system for the break-in run, the valve on the B-B storage tank suction line to the refrigerant accumulator was opened and the accumulator filled three-fourths full. A full head of water was placed on the refrigerant condenser and aftercooler. The 165-lb. steam line to the jacketed preheater was cracked open and all lines set by opening all valves. The compressors were started by venting them to atmosphere. When liquid appeared at the compressor vents, the operation was completed and the vent shut off. Refrigerant was then ready to be charged to the contactor.

▼ **Hydrocarbon distillation section flow.** The pressure of the acid stripper serves to charge bottoms from that column to the deisobutanizer. This column is designed for a pressure of 150 lb. The design bottom temperature is 210°F., which is maintained by temperature control of steam to twin vertical reboilers using 45-lb. steam from the contactor turbine. The design tower top temperature is 130°F.

The deisobutanizer contains 50 trays on 24-in. centers with the feed entering at the 20, 26, or 32nd tray. Its input capacity is 38,332 lb. per hr.

The deisobutanizer is equipped with the previously mentioned reboilers, 4 exchanger-type, water-cooled overhead condensers, and an accumulator. Its controls include a liquid-level feed controller and a reflux rate of flow controller.

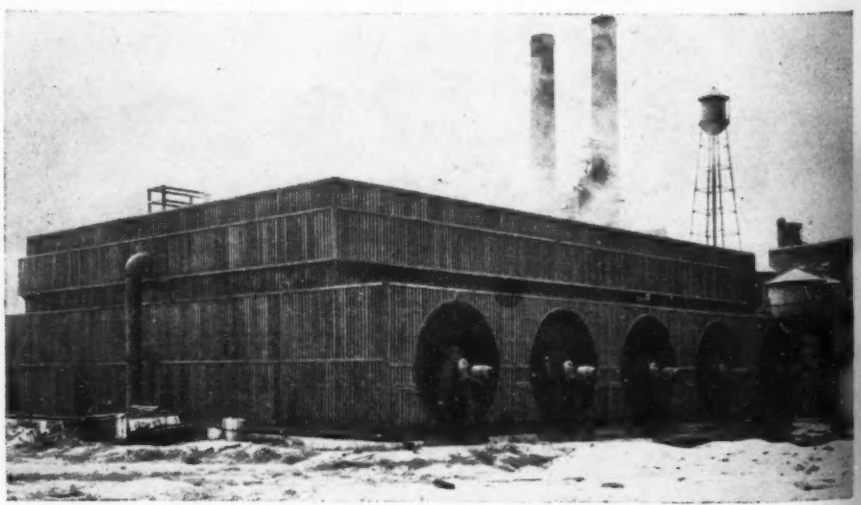
The overhead, isobutane, passes through the overhead condensers to the accumulator, then to the aftercooler, and thence to the isobutane recycle storage sphere. Reflux is pumped from the accumulator back to the column's first tray.

Bottoms are pumped to 2 process bauxite treaters connected in series for the removal of all organic fluorides. The process bauxite treaters are designed for a pressure of 168 lb. Their design temperature is 210°F. When bauxite in the treaters becomes concentrated with fluorides it is discarded and a fresh charge of bauxite added. The flow from the base of the treaters is through a preheater to the debutanizer.

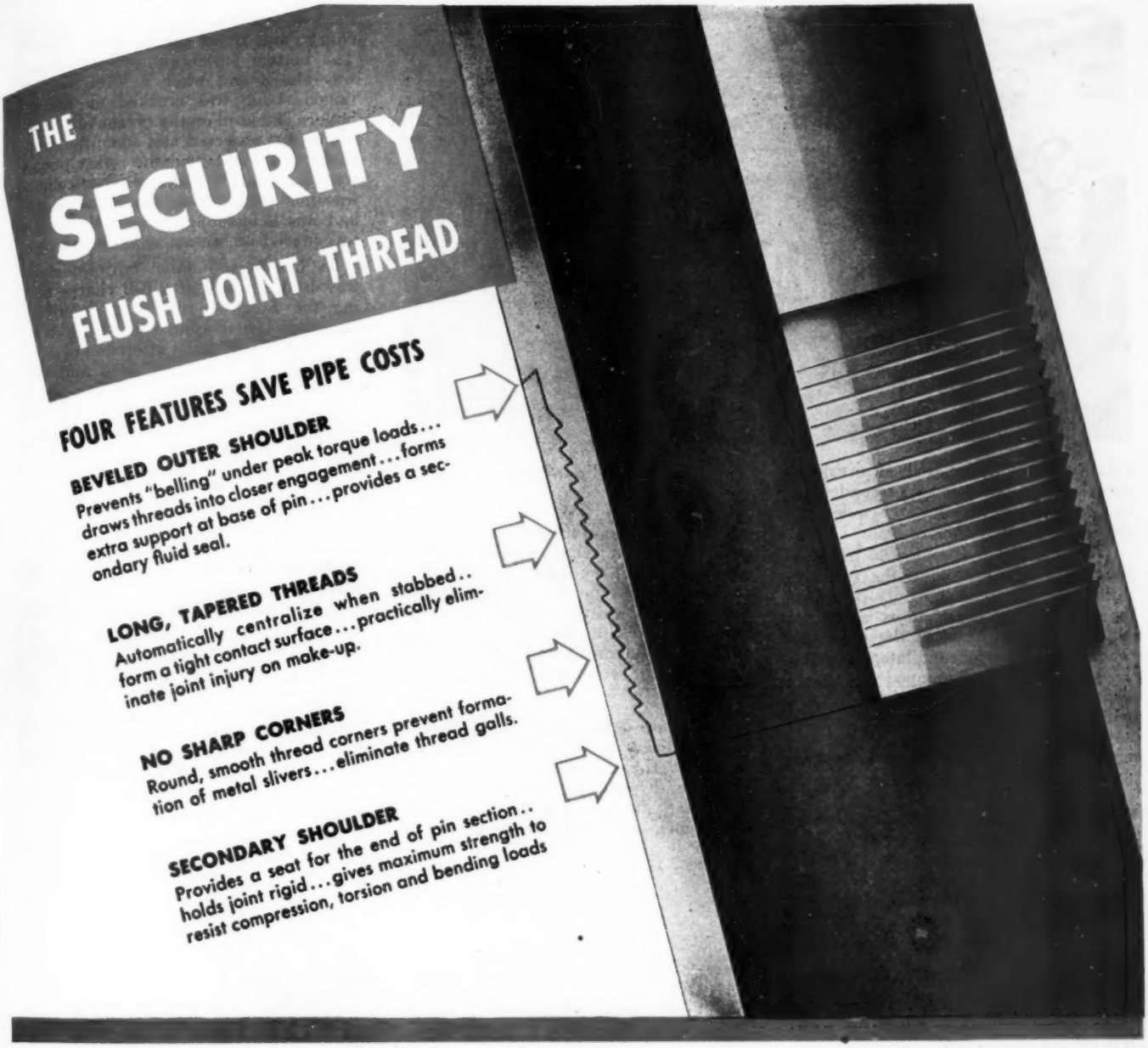
▼ **Debutanizer.** The debutanizer is designed for a pressure of 170 lb. Its design bottom temperature is 340°F. maintained by a vertical reboiler using 165-lb. steam on temperature control. The design top temperature is 130°F.

In addition to the reboiler, the de-

Cooling tower.



THE SECURITY FLUSH JOINT THREAD



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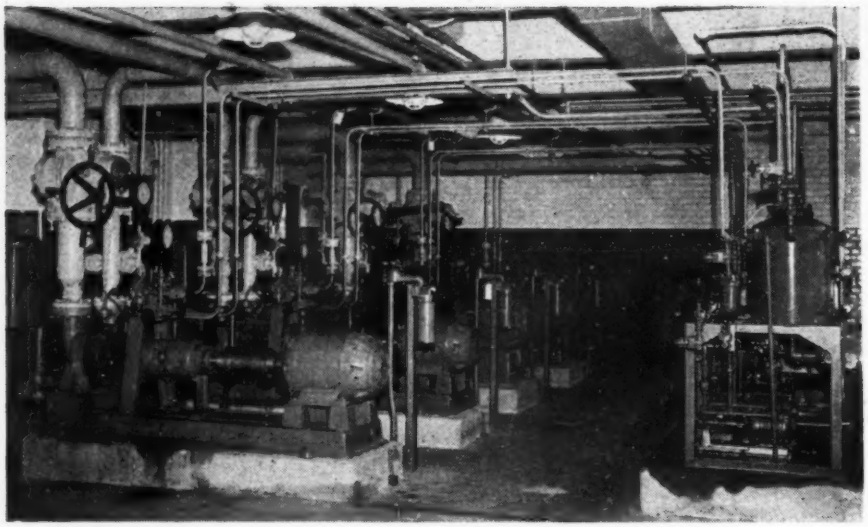

Acid pumps.

butanizer is equipped with an overhead water-cooled, exchanger-type condenser, an accumulator, and a water-cooled exchanger-type aftercooler.

The debutanizer contains 30 trays on 24-in. spacing. Feed enters the 7, 11, or 15th trays. Its input capacity is 15,020 lb. per hr. The overhead is n-butane, which is passed through the overhead condenser to the accumulator, then to the aftercooler, and pumped to butane storage. Reflux is pumped from the accumulator back over the column's first tray. Light and heavy alkylate, as bottoms from the debutanizer, are charged to the alkylate rerun column.

▼ **Alkylate rerun.** The design pressure of the alkylate rerun column is 113 lb. Its design bottom temperature is 375°F., maintained by a vertical reboiler using 400-lb. steam on temperature control. The design top temperature is 225°F. The column contains 16 trays on 24-in. centers and its input capacity is 10,100 lb. per hr. Feed enters on the seventh tray.

The rerun column is equipped with an overhead water-cooled condenser and an accumulator. Overhead from the rerun column is light alkylate, which passes through the condenser to the accumulator from which it is pumped to light alkylate storage. Reflux is from the accumulator back over the first tray. Heavy alkylate, as bottoms, is pumped through a water-cooled aftercooler and then to heavy alkylate storage.

▼ **Preparing the deisobutanizer.** With the feed line control valve closed, the deisobutanizer was lined up for normal flow. The feed inlet valve to the deisobutanizer's 26th tray was opened as were the inlet and outlet valves on the overhead condensers, the accumulator and the aftercooler up to the inlet line to the isobutane recycle storage sphere. Valves on the influx pumps were also opened.

Water was put on the 4 overhead condensers and the duraseal sets serving the charge and reflux pumps started. The liquid-level regulator control valve, regulating feed to the deisobutanizer, was opened admitting charge. The operator observed the level in the bottom of the deisobutanizer and when a level was obtained, steam was cracked to the reboilers.

▼ **Lining up debutanizer.** the debutanizer was lined up by opening the valve on the overhead condenser line to the condenser bypass. The valve to the accumulator, the reflux pump valve, the reflux line, and the aftercooler were likewise opened. Duraseal sets serving charge and reflux pumps were started. The bottom outlet on the debutanizer was closed and when a level was obtained steam was cracked on the reboiler. The level on the overhead accumulator was observed and when the proper level was obtained the reflux pumps were started. The alkylate rerun column was not used during the break-in run and was held inoperative until the unit was placed on stream with B-B charge.

As has been pointed out, isobutane was used in place of a B-B charge during the break-in run here described. This run lasted approximately 6 days. At 3:00 o'clock on the afternoon of June 16, HF acid was charged in and this operation was completed by 4:00 o'clock that afternoon. At 5:00 o'clock, B-B was charge in placing the new unit on stream and light alkylate was being produced by midnight—only 7 hours later.

▼ **Acknowledgments.** The writer desires to acknowledge the valued assistance of W. A. Budd, assistant foreman, and R. E. Redfield, project engineer, Socony-Vacuum Oil Company, Inc., who assembled the data from which this article was written. He also acknowledges the efforts of J. I. Lawrence, project manager, The Fluor Corporation, Ltd. He is indebted to D. L. Hooker, manager of eastern and foreign refineries, Socony-Vacuum Oil Company, Inc., H. W. Sheldon, general manager of the Paulsboro refinery, and Daniel McCarthy, director of publicity, for the many courtesies granted during his stay at Paulsboro.

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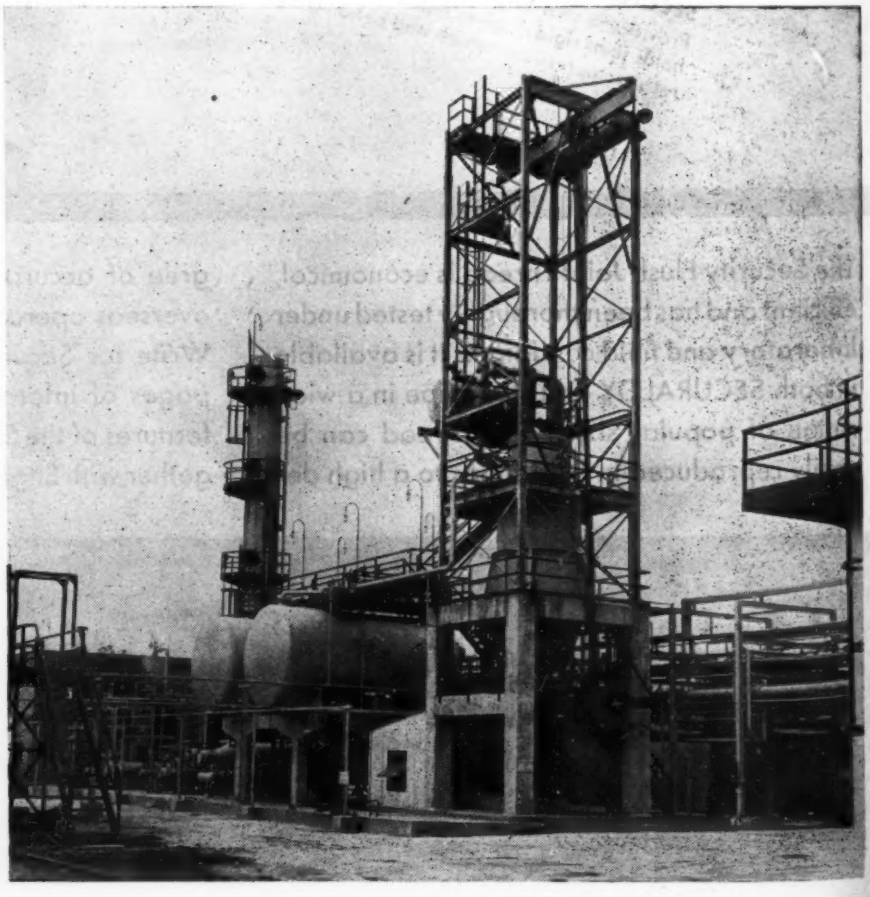


View of acid section showing, right to left: Stratco contactor, acid surge tank, acid settler, HF acid stripper.

CALIFORNIA REFINERY FACILITIES EXPANDED

Additions to plant of The Texas Company increase production of 100-octane aviation gasoline and other grades required for the Allied armed forces.

AN EXPANSION program completed on August 31 at the Los Angeles Works Refinery of The Texas Company at Wilmington, California, involving an expenditure of approximately $21,000,000, will increase the company's facilities for meeting military demands for petroleum products.

Prior to Pearl Harbor, December 7, 1941, this refinery was operating at a charge rate of 30,000 bbl. of crude oil per day, producing 2000 bbl. of 100-octane aviation gasoline, various grades of civilian gasoline, kerosine, stove oil, diesel oils as well as U. S. Navy Special Grade fuel oil and several grades of civilian fuel oils.

Immediately after the Pearl Harbor attack, The Texas Company began to consider facilities at its Los Angeles Works for the manufacture of additional military poducts. The principal objective of these new operating facilities was to increase the production of 100-octane aviation gasoline and other grades of gasoline required by the military for the successful prosecution of the war.

To accomplish this purpose, it was necessary to provide:

a. Additional crude stilling capacity.

b. Additional fractionating capacity for straight run naphthas and natural gasolines.

c. A new fluid catalytic cracking unit for the production of additional olefins and isobutane, to be utilized in the manufacture of alkylate, and for the production of isopentane and base naphtha fractions, all to be used in the manufacture of 100-octane gasoline.

d. A new plant for the production of alkylate, the base used for the manufacture of 100-octane aviation gasoline. These facilities include a new feed preparation unit for the improvement of alkylation plant charge.

e. The installation of new tankage, and new lines as well as changes and additions to existing lines was required to permit the proper use of the new operating facilities installed.

f. Additional steam generating facilities, new water well and cooling towers.

A brief description of the new operating facilities at the Los Angeles Works is given below:

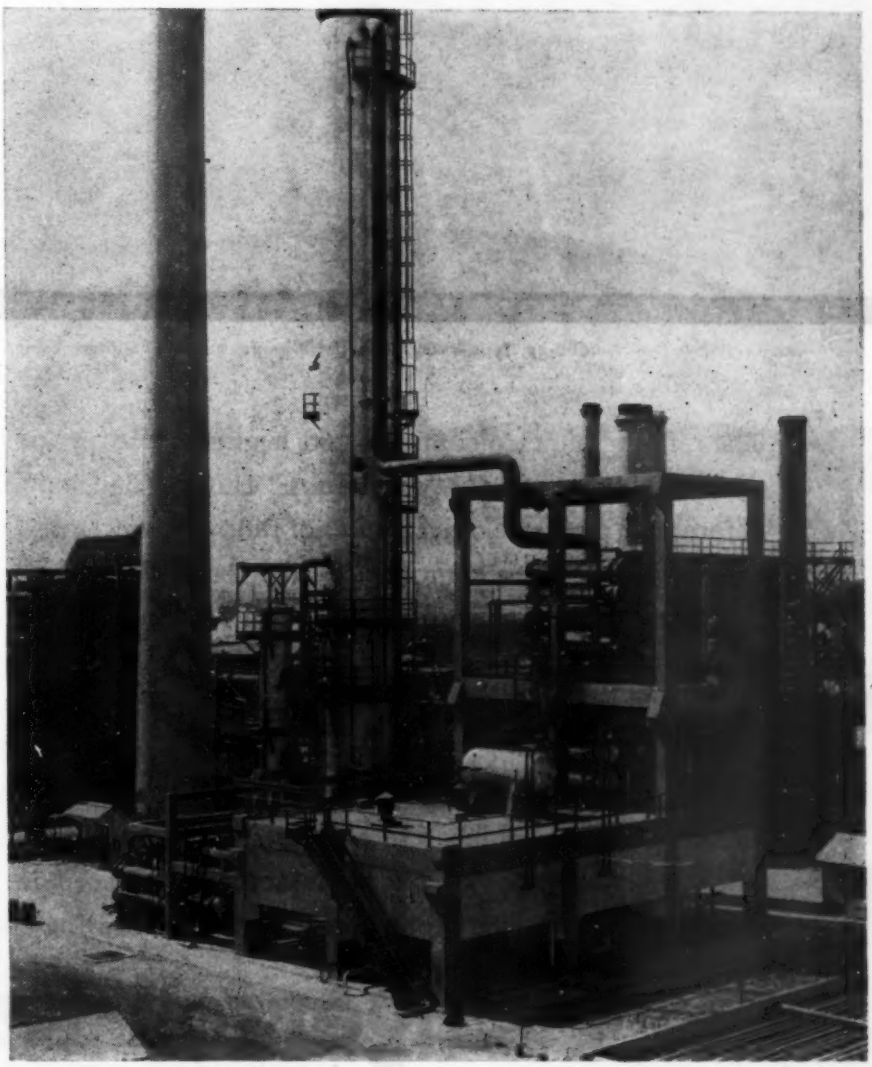
▼ **Crude stills.** A new crude still unit capable of running 12,500 bbl. per day of 36-42 API gravity crude oil has been completed and is in operation. This unit consists of a pipe still furnace, an 11 ft. by 120 ft. fractionating tower, two 4 ft. by 11 ft. 6 in. stripping towers together with the required pumps, lines, condensers, coolers, and other necessary auxiliary equipment for efficient operation. This unit will produce straight run naphtha of any desired endpoint, kerosine distillate, gas oil, and a straight run fuel residuum of 250 to 300 Saybolt Furol viscosity at 122° F.

This crude unit was so designed as to permit the refractionation of 7500 bbl. per day of 375° F. straight run naphtha produced on other crude still units at this plant, an operating procedure that is rather novel and unusual; it eliminates the necessity of a separate rerun unit for such purposes.

▼ **Superfractionator.** This equipment was designed for the processing of 15,000 bbl. per day of combined charge made up of depropanized natural gasoline, straight run naphtha, vapor recovery compressor gasoline and any pentane and lighter fractions from the No. 1 and No. 2 akylation plant operations.

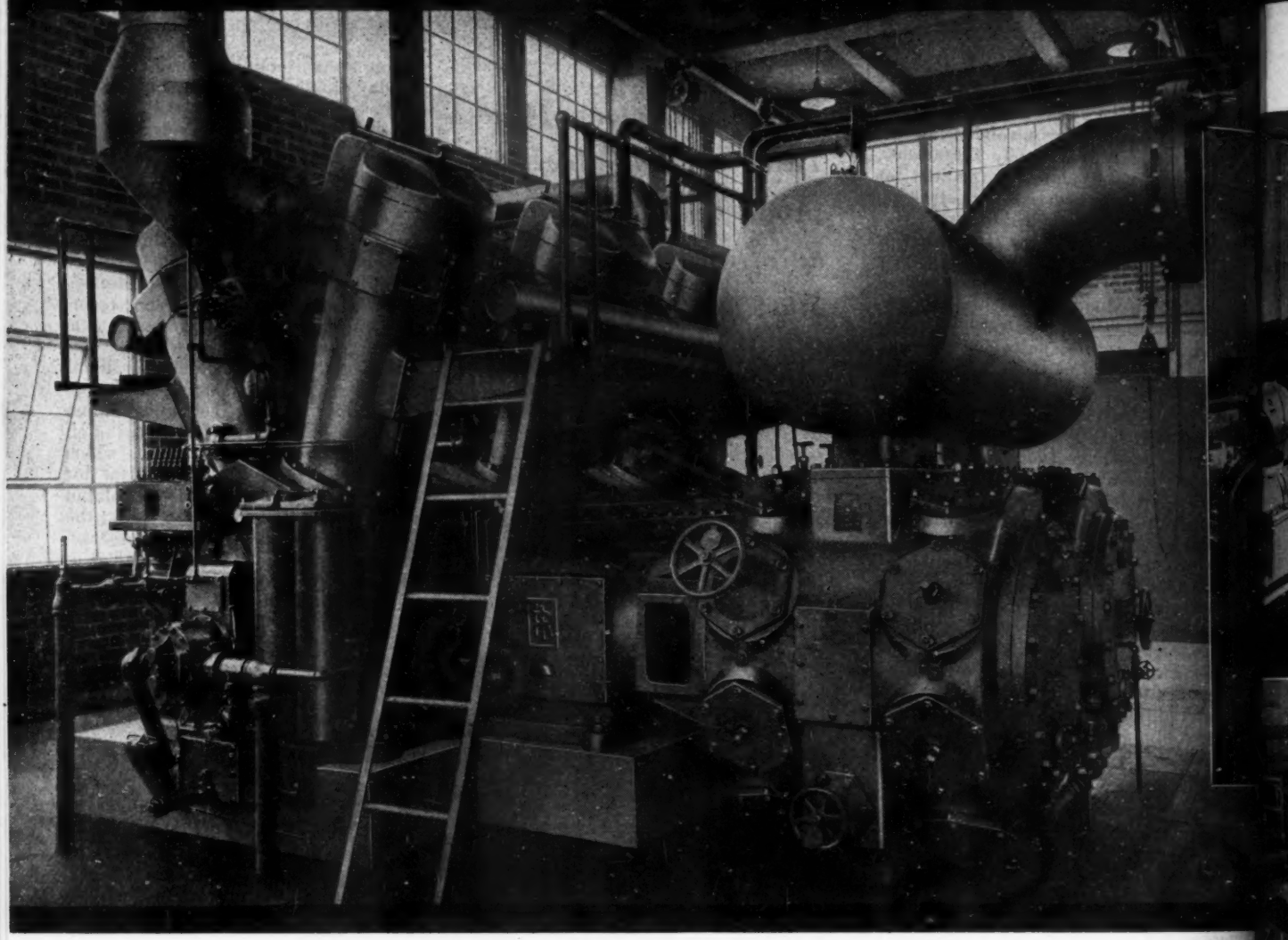
There are six fractionating towers operating in this unit. The first column debutanizes the charge, fractionating off an isobutane-n-butane fraction, which goes to the No. 2 alkylation plant for further processing; the second column depentanizes the debutanized stock; the third column splits the pentanes fraction into isopentane and normal pentane; the fourth, fifth, and sixth columns

(Continued on Page 100)



Crude distillation and naphtha rerun unit of The Texas Company.

that must be finished before th



600-hp, Type KVG, four-cycle, V-angle, gas-engine-driven compressor handling refinery gas.

The refining of petroleum products begins when the refinery goes "on stream." But before tnat moment, other phases of refining must have been completed...like the development of the process, the design of the plant, and the selection of the equipment that can and will stay "on stream."

Take, for example, pumps and compressors that are so essential in every refinery. Such machines are able to stay "on stream" because of the manufacturer's ability to meet the problems involved, to properly apply its product, and to develop and produce new products to meet new conditions. This means constant refinement of design, materials and manufacturing methods.

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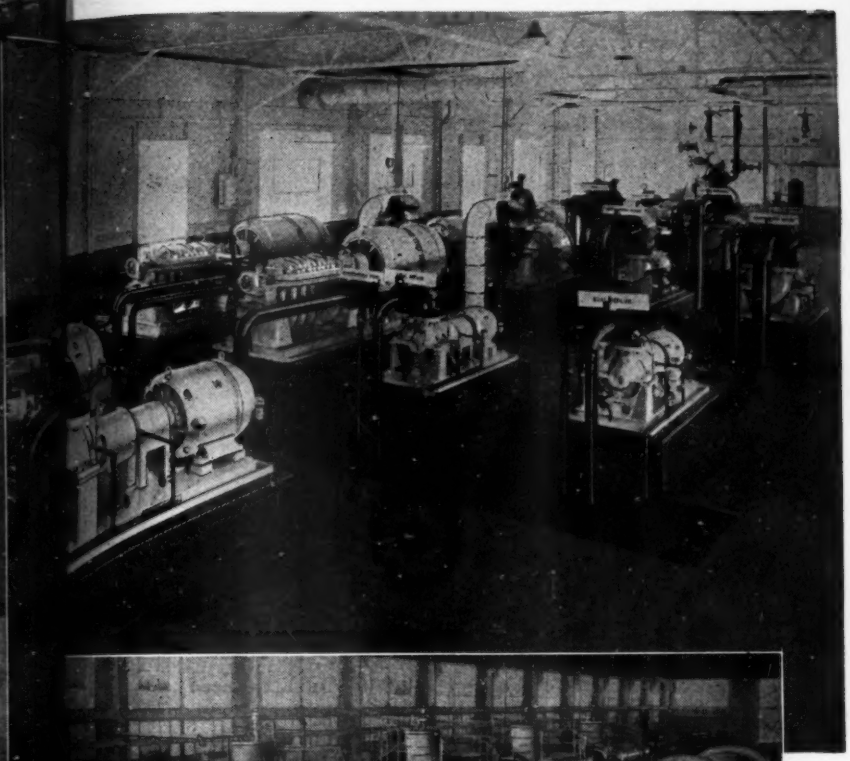
A group of Ingersoll-Rand, single-stage and multi-stage refinery pumps operating at various pressures and temperatures.



Every new refining process has made use of Ingersoll-Rand (Cameron) Pumps... pressures up to 2000 psi, temperatures to 800° F. You should know about the I-R "Shaft Seal", too. There is an I-R pump for every refinery purpose today; there will be new ones, if necessary, for tomorrow's refinery.

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Air-starting compressors for any-size engine installation.

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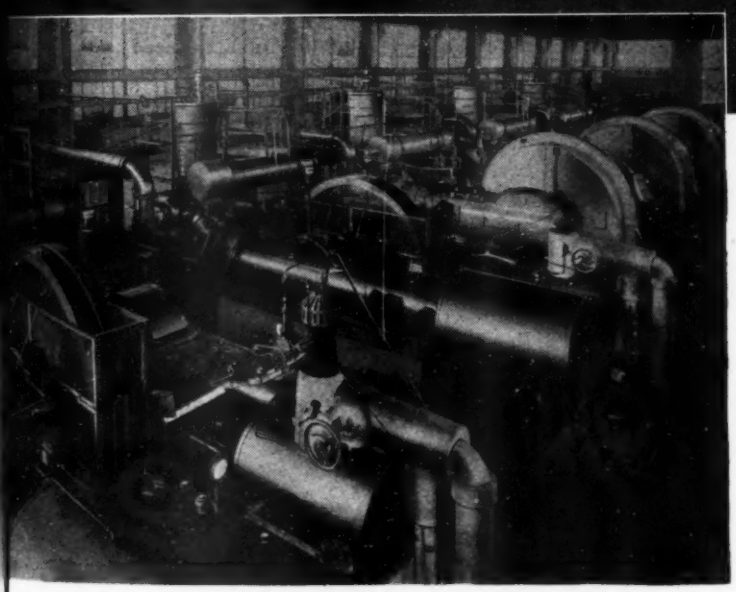


Steam-driven Type XPV, and electric-driven Type XRE, high-pressure compressors.

A complete range of I-R Turbo-Blowers... to 15,000 hp for capacities up to 125,000 cfm... for catalytic cracking, combustion air, and other refinery uses.

4-cycle, V-angle, heavy-duty gas engines from 185 to 800 hp... 4-cycle, heavy duty Diesels from 200 to 600 hp. Suitable for driving station and pipeline pumps, generators, blowers, etc.

Steam-Jet Coolers, using water as the only refrigerant, for producing temperatures down to 35° F... sizes 10 to 600 tons per 24 hr.

Heavy-Duty reciprocating compressors for handling any refrigerant... temperatures down to 80° F below zero... sizes up to 3000 hp.

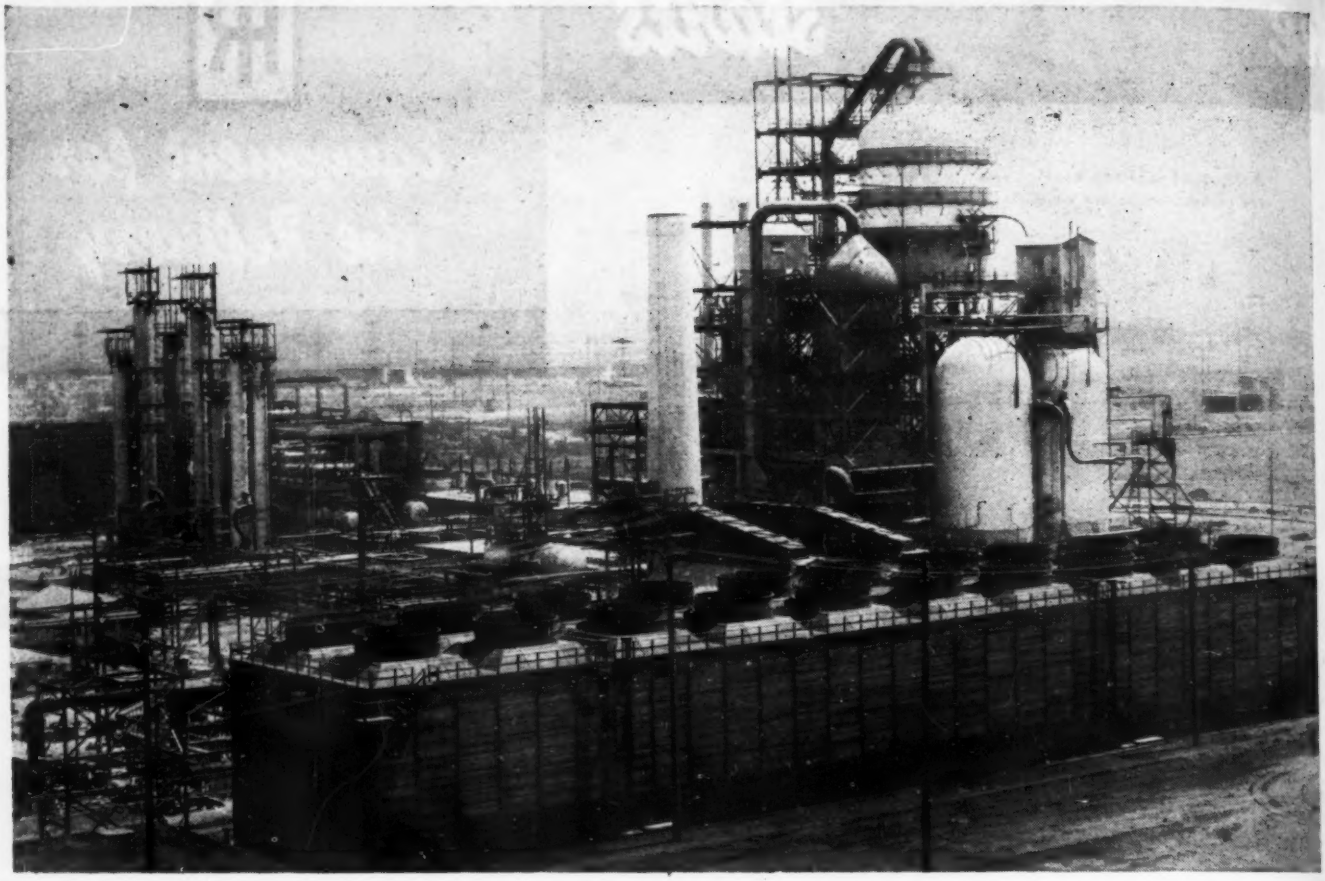
Four 370-hp, Type PVG, four-cycle, gas-engine generator units.

A complete range of steam-jet ejectors, thermal compressors, barometric condensers, and surface condensers. Many of these incorporate distinctive I-R developments.

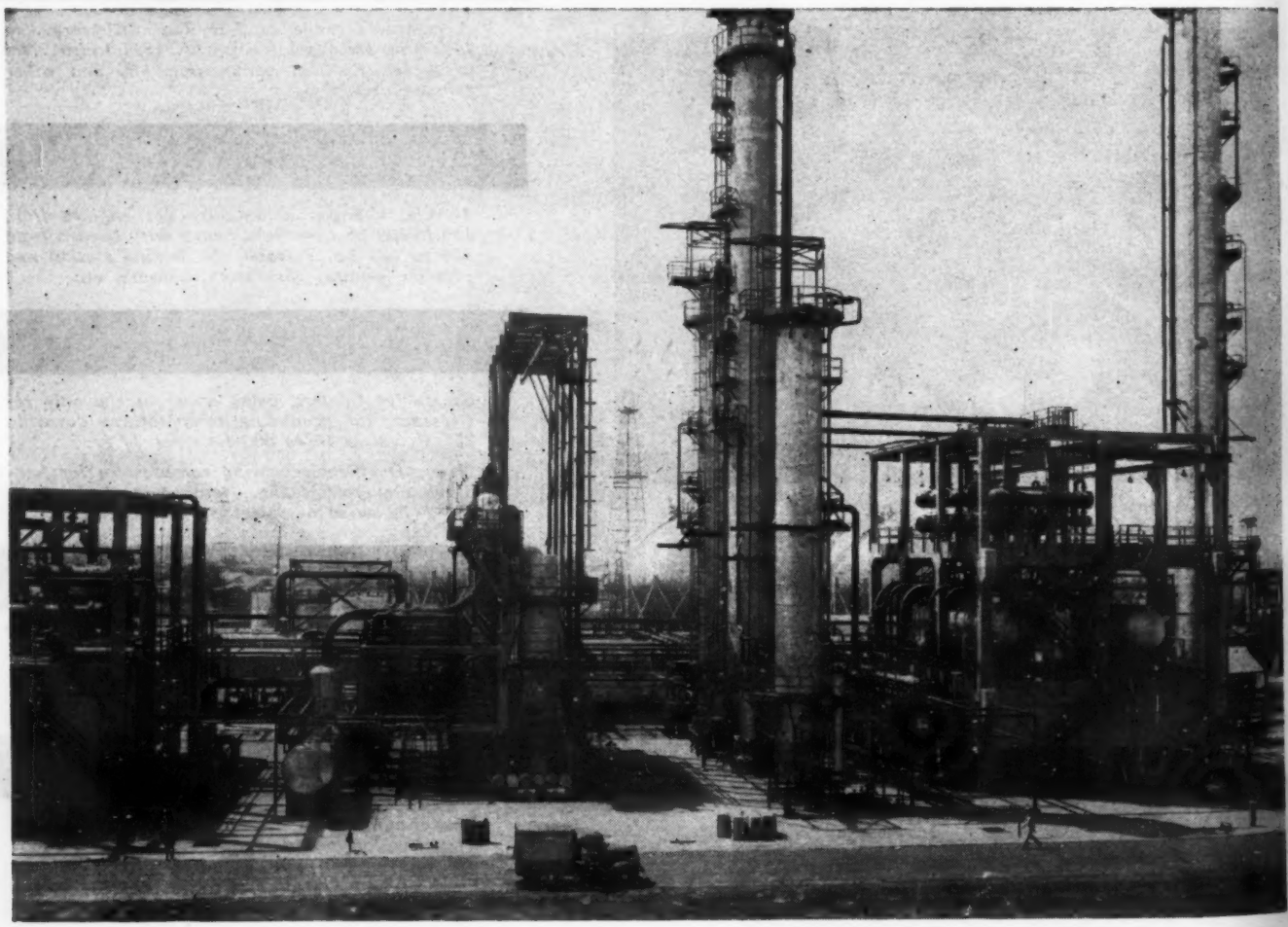
For construction and maintenance: impact wrenches for loosening and running-up nuts... up to 1¾" bolt size, grinders, drills, concrete breakers and vibrators, riveters, scalers, hoists, sump pumps.

14-514

(Continued from Page 97)



Above, fluid catalytic cracking unit with fractionating section in left foreground; 30,000 g.p.m. induced draft cooling tower in foreground. Below, sulphuric acid type alkylation unit at The Texas Company plant.



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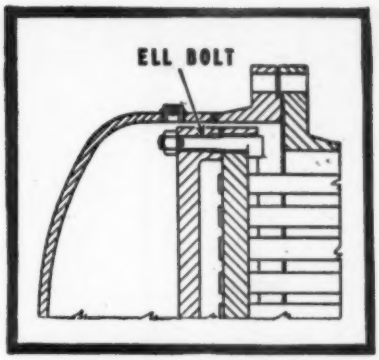

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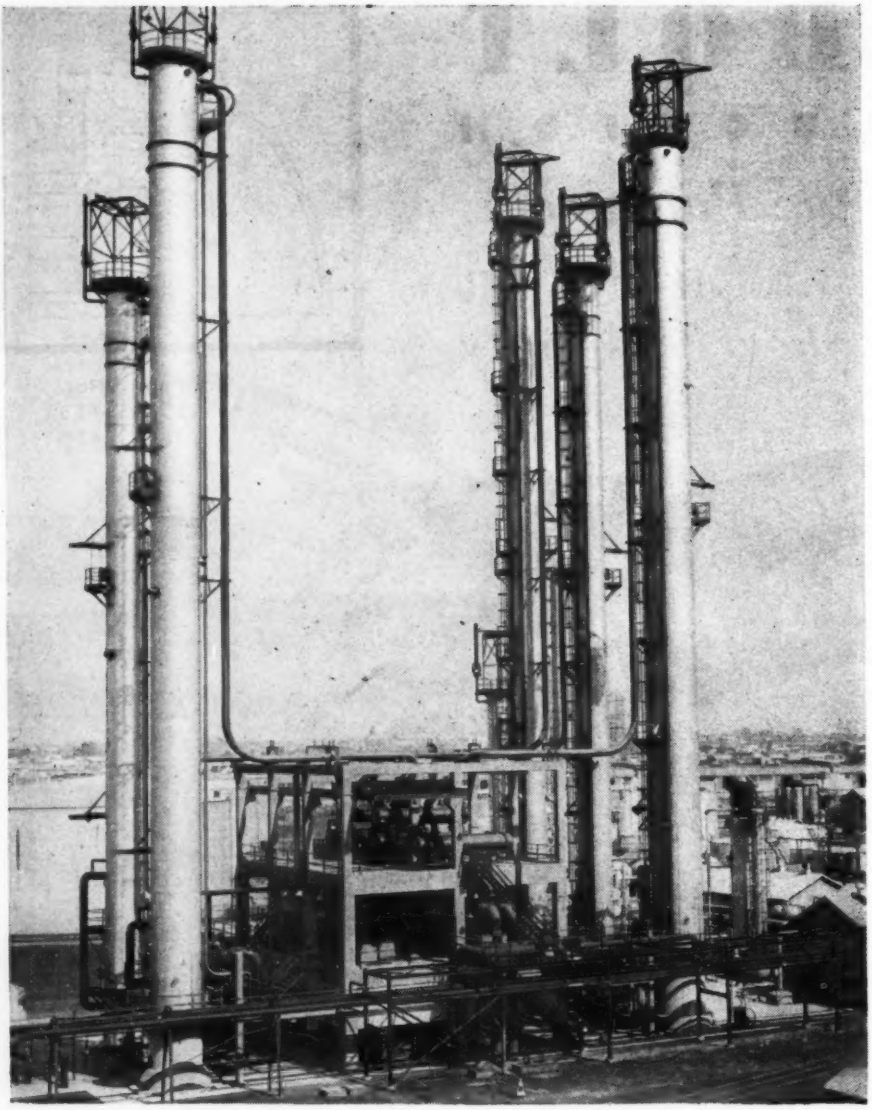

Superfractionator designed to produce 6 closely fractionated hydrocarbons at The Texas Company's Los Angeles Works, California.

produce as overhead products, respectively, a hexanes-isoheptane cut, an n-heptane cut, and an isooctane cut. The bottoms from the sixth tower are n-octane and heavier. The respective products are segregated for use to the best advantage in military aviation products, motor gasoline, and for further processing.

The dimensions of the columns are as follows: debutanizer 6 ft. 6 in. by 67 ft. 8 in., depentanizer 6 ft. by 129 ft., deisopentanizer 8 ft. by 162 ft., deisoheptanizer 9 ft. by 160 ft. 6 in., deheptanizer 7 ft. by 163 ft., and deisooctanizer 6 ft. by 145 ft.

▼ **Fluid catalytic cracking unit.** A new unit for the production of certain desired hydrocarbon fractions by the use of catalytic cracking was installed and is now starting operation. This unit consists of a reactor, a regenerator, a precipitator, a bubble tower, and fractionating equipment. This operation consists of contacting the charge with a powdered synthetic catalyst at temperatures between 950° F. and 1050° F., dependent upon the final products desired.

After the reaction between the catalyst and the oil charge, which by the way is a distillate having a distillation range between 375° to 900° F., the vapors are cooled and go to the fractionating side of this unit where the catalytic distillate is depropanized and split into butylenes, pentylenes, C_5 — 185° F. and fractions boiling between 185° F. to 210° F.; 210° F. to 300° F.; 300° F. to 400° F. as well as light and heavy cycle gas oils. These products are delivered to storage for further processing at the alkylation units, treating plants, and other operating departments.

This fluid catalytic cracking operation is unique in its mechanical control apparatus. More than 500 control instruments are in use on this unit, the failure of any one of which could seriously affect the efficient operation of this equipment.

▼ **New alkylation unit and feed preparation unit.** The new feed preparation unit is used to improve the quality of both the thermal and catalytic olefins prior to their use on the alkylation units.

A caustic wash is given the thermal butylenes for mercaptan removal and a weak acid treatment is given the thermal pentylene for removal of diolefins. A rerun operation is provided for the removal of any polymers that might be produced in the weak acid treating operations.

The catalytic butylenes are given no treatment of any kind. The catalytic pentylenes are caustic washed for mercaptan removal and also are given a weak acid treat for diolefin removal with a resultant rerun for removal of polymers.

The following columns are included in the feed preparation unit: a 3 ft. and 5 ft. by 88 ft. 6 in. primary depropanizer, 2 ft. by 38 ft. thermal olefin and 3 ft. 6 in. by 42 ft. catalytic pentylene caustic washers, a 3 ft. by 26 ft. caustic regenerator, a 3 ft. and 4 ft. by 76 ft. primary debutanizer, and a 3 ft. by 41 ft. 6 in. rerun tower.

The new alkylation plant facilities consist of the necessary fractionating towers, acid contactors, neutralizing equipment and rerun stills to permit the combination of olefinic butylenes (C_4) and pentylenes (C_5) with isobutane to produce alkylate, which is the base for the manufacture of 100-octane aviation gasoline. During this process depropanization, deisobutanization, and debutanization of either the charge or the resultant products take place as well as a final rerun operation to eliminate the polymers produced in the alkylation process.

The equipment in the new alkylation unit consists of four Stratco type 50 contactors, an 8 ft. by 128 ft. product debutanizer, a 10 ft. by 162 ft. 6 in. deisobutanizer, 6 ft. by 87 ft. depropanizer, and a 7 ft. by 63 ft. final fractionator.

As a result of this new equipment The Texas Company can process 42,500 bbl. per day of crude oil, can produce more than 12,500 bbl. per day of aviation gasolines, of which more than 10,500 bbl. daily is 100-octane gasoline, can produce 2000 bbl. of additional military gasolines other than aviation grades as well as supply its essential civilian demands.

It may be of interest to note that more than 50 per cent of the total gasoline production at the Los Angeles Works of The Texas Company will be of aviation grade and more than 65 per cent of its total gasoline manufacture is for the United States military forces.

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Wages increase 130%

Wage payments to employees by the petroleum refining industry have increased approximately 130 per cent in the last five years, according to calculations from official government figures. At the same time the industry has been unable to obtain reflection in the prices of its finished products of such a percentage increase in cost. Product prices have been changed little while the extra load added by increase in wage payments has been $130,000,000.

DUAL COMPLETIONS IN THE NEW HOPE FIELD

By C. C. PRYOR, *Associate Editor*

EXCLUSIVE THE production division of the petroleum industry had been concerned with the problems involved in dual completions of wells for a number of years before the war; however, the shortage of materials and manpower coupled with the drilling-time factor has caused dual completions to become a highly important tool in the hands of the production engineer. Dual completions are not always entirely successful due to the characteristics of the fields in which the method is employed. One of the major difficulties is high gas-oil ratio in the formation producing through the annular space. Large volumes of gas tend to break out of solution with the oil in the annulus due to the gas expansion and friction on the outside of the tubing and inside the casing in flowing to the surface. As yet no method has been devised that is completely successful in eliminating this difficulty.

Among the economies resulting from dual completion of wells are two of equal importance. One economy is the quantity of steel saved. The quantity of steel saved in a dually completed well can be found by subtracting the amount necessary for the dual well from the amount for two wells; one drilled to each sand. Drilling and completion cost constitute the other economy and the difference saved by the dual completion can be found by the same method in finding the steel saved. Dually completed wells can produce as much oil from one well as can be produced from two wells.

As a result of these facts most states have approved rules and regulations permitting dual completions under adequate supervision.

The ideal field for dually completed wells is one in which there is sufficient reservoir pressure to cause the wells to flow, little or no water production, a low gas-oil ratio, and production of a reasonably high gravity crude oil. These ideal conditions exist in the New Hope field in Franklin County, Texas.

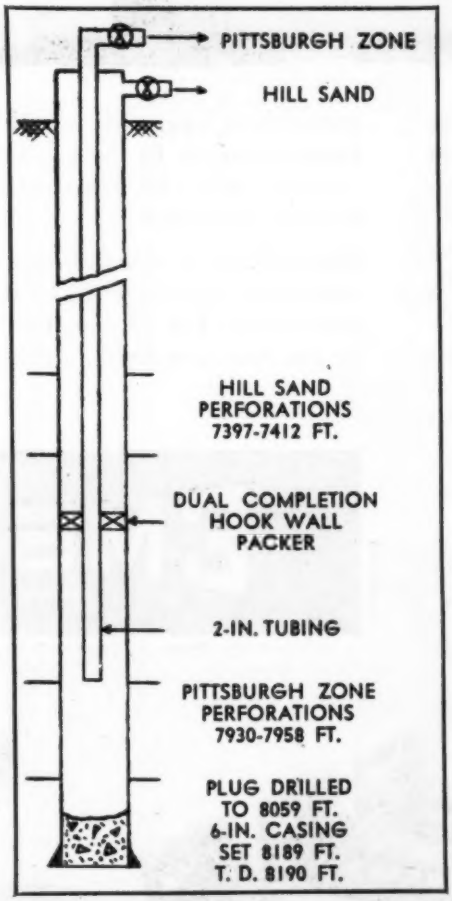

Fig. 1. Sketch showing a typical dual completion in the New Hope field in the Hill sand and the Pittsburgh zone.

Operated by a major oil company, all wells in the field are dual completions. Production is obtained from four widely separated sands containing four distinctly different crude oils ranging in gravity from 43° to 52° API. Separator gas was barely sufficient to use as fuel for 6 power rigs and one steam rig from 12 wells that were dually completed. There is no water present in the production and wellhead pressures range from 500 to 800 lb. The producing formations are found at depths from 7280 to 8200 ft. as follows: Bacon lime, 7280 ft.; Hill sand, 7400 ft.; Pittsburgh zone, 7925 ft., and the Elledge sand, 8200 ft. Production from the Bacon lime has a gravity of 43° and is a dark brown colored oil, the Hill sand oil, 45° gravity, is a black oil, the Pittsburgh is a dark green oil having a gravity of 49°, and the Elledge is a cream colored oil of 52° gravity. Where it is possible the operator completes the dual wells in the Hill sand and Pittsburgh zone.

In order to speed development of the field two types of rigs are used on the well before production is obtained.

The hole is drilled to bottom by large standard rotary rigs. After casing has been run and cemented this rig is moved to a new location to drill another well

Below—Photograph of dual completion tank battery. The twin separators and meter runs shown in foreground.

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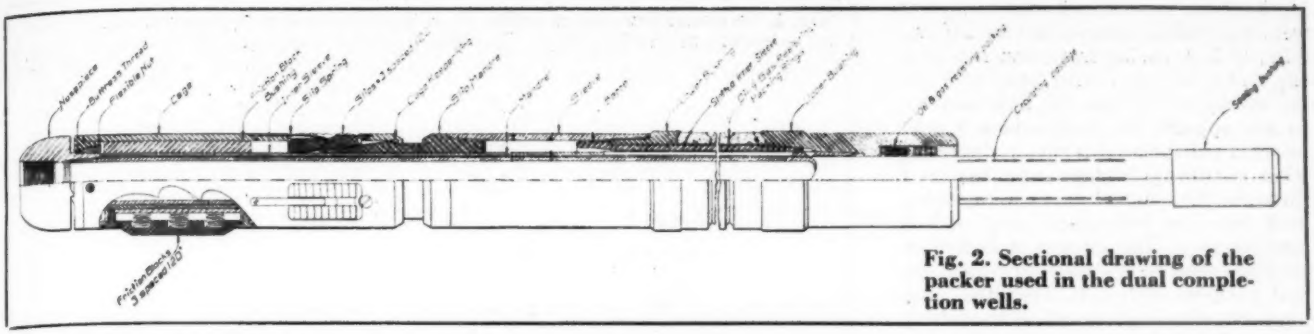


Fig. 2. Sectional drawing of the packer used in the dual completion wells.

and a portable rig moved in for completion. Total drilling and completion time for each well is approximately 78 days. In drilling the wells a 12¼-in. hole is drilled and reamed to 17½ in. for 220 ft. of 13⅜-in. surface casing, which is cemented with 350 sacks of regular cement. Drilling is continued with a 12¼-in. hole to 4800 ft. and 9⅝-in. casing set and cemented with 1000 sacks of slow set cement. From 4800 ft. to the total depth of the well an 8¾-in. hole is drilled and either 5½-in., 6-in., or 7-in. casing set 1 ft. off bottom and cemented with approximately 1200 sacks of slow set cement. Drilling mud is carefully checked during drilling to prevent water loss to the formations. Average mud weight is 9.9 lb. per gal. The tubing for the well is run and the wellhead controls connected at the surface. The drilling rig is then moved off and the completion rig moved on. After drilling the plug to a point about 50 ft. below the producing formation, a 3-ft. section of the lower zone is perforated and tested. If the test is satisfactory the upper zone and the remainder of the lower zone is perforated. A milling cutter is run to remove obstructions in the casing and then the packer is run to a point about halfway between the two producing zones. The sands are then washed in and the packer set. Fig. 1 is a sketch showing a typical dual completion in the Hill sand and the Pittsburgh zone in the New Hope field.

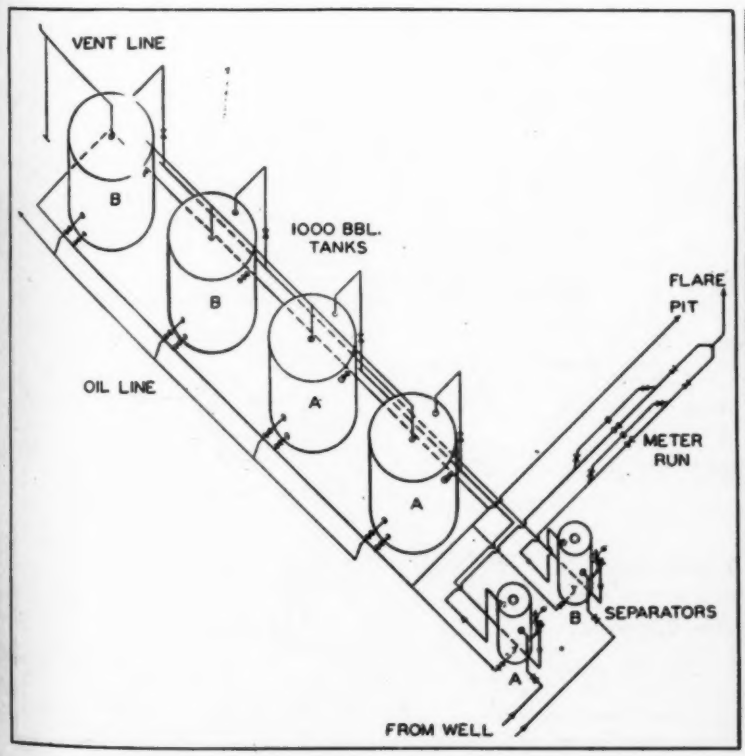
▼ **Dual completion packer.** The packer employed by the operator in the New Hope field is a hook wall control head type and is shown in Fig. 2. A 12-in. slotted valve opening is provided in the packer to eliminate cutting action while running the packer or circulating drilling mud under high oil and gas pressures. When closed, the valve provides a positive shutoff and confines the lower zone pressure to the tubing. The valve arrangement contains 3/32-in. wide circulating slots. Closure of the valve after the packer has been set is accomplished by moving the tubing down slowly in the well and the circulating slots are sealed in an arrangement of chevron type packing rings. The packing element of this tool consists of 6 oil and gas resisting rings to provide a positive seal and long life without sticking to the casing wall. Slips for the packer are arranged in a lower sleeve to eliminate the possibility of losing them in the hole and becoming fouled. Also danger to slips from fragments of cement, pipe burrs, etc., is eliminated assuring positive action when the packer is set.

The slips of the packer are set by rotating the string to the right and at the same time slacking off to apply pressure to the packing element for the set. Longitudinal movement releases the packer and restores automatic bottom to the releasing position. This action prevents the packer from continuing to set or swab while coming out of the hole and as it is not necessary to rotate the string to the left prevents backing the tubing off.

▼ **Wellhead Manifold.** A sketch of the wellhead manifold employed is shown in Fig. 4. The sketch shows the five sections of the manifold and flowline connections. This tree is primarily designed for use in wells where the tubing will remain connected to the packer as is the case where a hookwall type packer is used and is particularly adapted for dual completion work.

The 13⅜-in. casing nipple screws into the housing of section A, the 9⅝-in. cas-

Fig. 3. Diagram showing connections of dual completion battery.



Dual completion wellhead manifold used in the New Hope field.

ing is swung in section A with a slip test weld type casing hanger, and the 5½-in., 6-in., or 7-in. casing in section B with a slip test weld type casing hanger. When the tubing is run into the hole and the packer opposite the point where it is to be set, a polished-rod is run on the string with a tubing hanger and lowered through the control equipment being used into the tubinghead seat with a landing joint. The hanger is locked in position with set screws provided for that purpose, section C. Then the landing joint is backed out and, as the tubing hanger has sealed the annulus, the control equipment is removed. The landing joint is again screwed into the coupling, the tubing raised, and the christmas tree screwed onto the top of the polished-rod, section D. At this stage of installing the manifold completion operations on the well are carried out and both sands brought in. Then the bottom flange on the christmas tree in section D is raised the proper distance above the top flange on the tubinghead, section C, to provide the required downward movement to set the packer and put the proper weight of tubing on the packer. With the flanges in this position, the packer is ready to set by lowering the tubing and rotating to the right. Then the proper amount of weight is put on the packer and the flanges brought together for bolting. This leaves the equipment in permanent position as shown in the photograph.

If it is desired to release the packer the bottom flange of the christmas tree is unbolted from the tubinghead and the tubing is raised. Thus the well can be killed, the packer reset, and other such operations performed without taking off the christmas tree and without plugging the tubing. The tubing is actually connected and supported by the bottom connection on the christmas tree, and the part normally regarded as the hanger is actually a removable stuffing box. This type construction is particularly advantageous in dual or triple zone completions, as it follows the packers to be adjusted, permits acidizing, washing, etc., without removing the christmas tree, and with the well under complete control at all times.

▼ **Dual completion tank battery.** Storage tanks and separators for these dually completed wells are of unusual design in that the oil from the two zones is kept separated until taken by the pipe line company. Flow lines from the wells enter separators, one for each line, at the tank battery (Fig. 3). Flow from the upper zone of the well enters separator A, the oil flows by gravity to the first two 1000-bbl. storage tanks, A. Separator B receives the production from the lower zone and the oil is stored in the second two 1000-bbl. tanks, B. Gas from the separators passes through the meter run into the field gas system or to the flare. The oil line can take production from the A zone tanks or the B zone tanks as desired by the pipe line company. All four tanks are manifolded for drainage to the burning pit. Vapor lines enter a common manifold.

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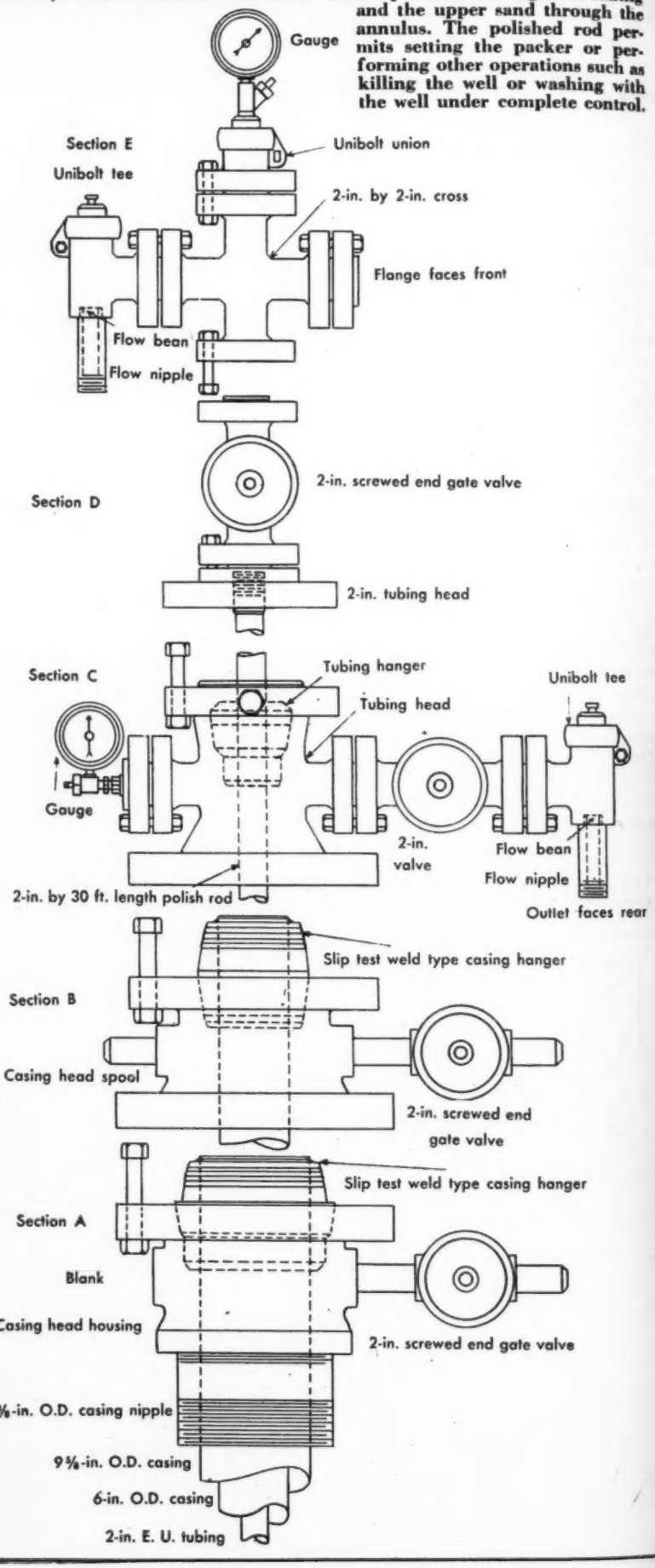
Fig. 4. Sectional drawing of wellhead manifold showing equipment and method of assembly of the 5 sections. The lower sand is produced through the tubing and the upper sand through the annulus. The polished rod permits setting the packer or performing other operations such as killing the well or washing with the well under complete control.



COMPLETE REFINERY CONSTRUCTED WITHIN CONFINES OF OLD PLANT

ON October 5, an extensive new refinery unit will join in the fight to conquer Japan when the Richfield Oil Corporation dedicates an addition to its plant at Watson, California.

In 1940, the Watson refinery became one of the first in the nation to produce the then new 100-octane aviation gasoline, and was well prepared to supply this vital, powerful fuel to the armed forces of the United States when in December, 1941, this country became involved in war.

Demand for high-powered aviation gasoline came so rapidly from allied nations that new units were constantly added at Richfield's Watson refinery to increase both the quality and quantity of the fuel. The construction of these additional units was accomplished without stopping production at any time. Because of a shortage of critical materials, one of these units—a cumene plant—was erected entirely from salvage and converted materials found in the plant, hauled in from oil fields, and machined to specifications in the Richfield refinery machine shop.

During the last year, a complete new refinery has been constructed within the confines of the old plant—also, without stopping production. This new plant will produce 1000 per cent more 100-octane fuel than was produced in 1940.

In addition to the cumene plant, other units erected include a thermofor catclytic cracking unit, gas plant, straight run fractionation unit, an alkylation unit, boiler plant, a cooling water supply system, an addition to the existing cooling water system, a thermal depentanizer unit, a combination unit gas oil stills, and thermocaustic wash and reclaimer units.

Installations made since 1940 represent an investment of $20,000,000, which brings the present valuation of Richfield's Watson refinery up to $40,000,000. More than 1900 construction workers were engaged on the project. Completion of the new unit will give more than 1000 persons employment in the postwar era. Of this number, a large proportion are trained specialists—engineers or technicians, skilled in the handling of refinery equipment. The new refinery will make possible a greater recovery of gasoline from each barrel of crude oil. Thus previous gasoline recovery rate from crude petroleum, which was 22 per cent by volume, has been increased to 44 per cent by volume, an increase of 100 per cent in actual gasoline yield from each barrel of crude oil processed.

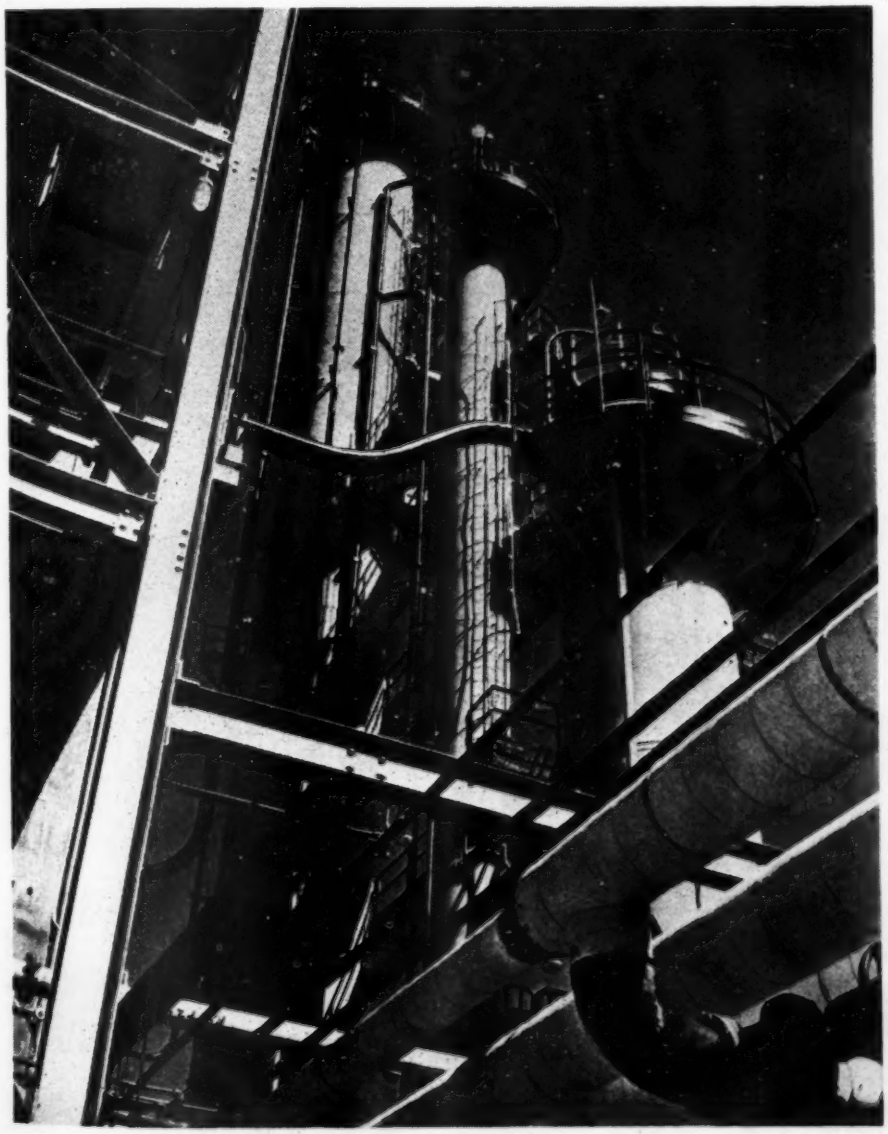
At the same time, it is now possible to produce gasoline of such high quality that motors have not yet been designed to utilize all the fuel power that is available.

The 100-octane plus gasoline now used in military aviation could be stepped up to even more powerful fuel were aviation engines designed to withstand the tremendous power available. Super fuel blends now used in aviation gasoline make possible shorter take-offs, speedier climbs, faster maximum speed at all altitudes, and longer cruising ranges.

Even these advantages, which are well known to the Axis airmen, can be expanded when new motors are designed

(Continued on Page 114)

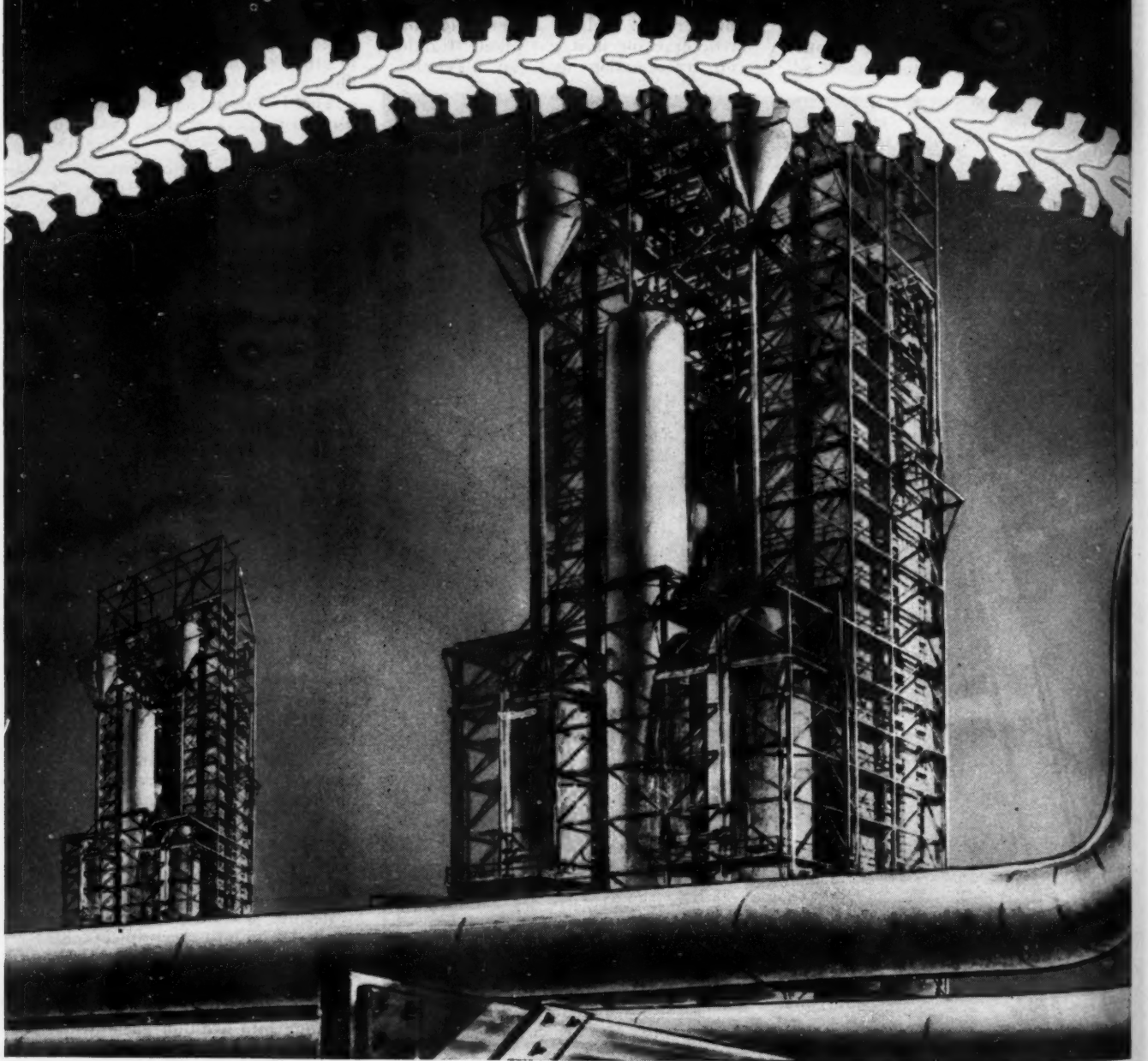
Without stopping production Richfield has erected facilities that will increase 100-octane gasoline output by 1000 per cent in comparison to 1940.

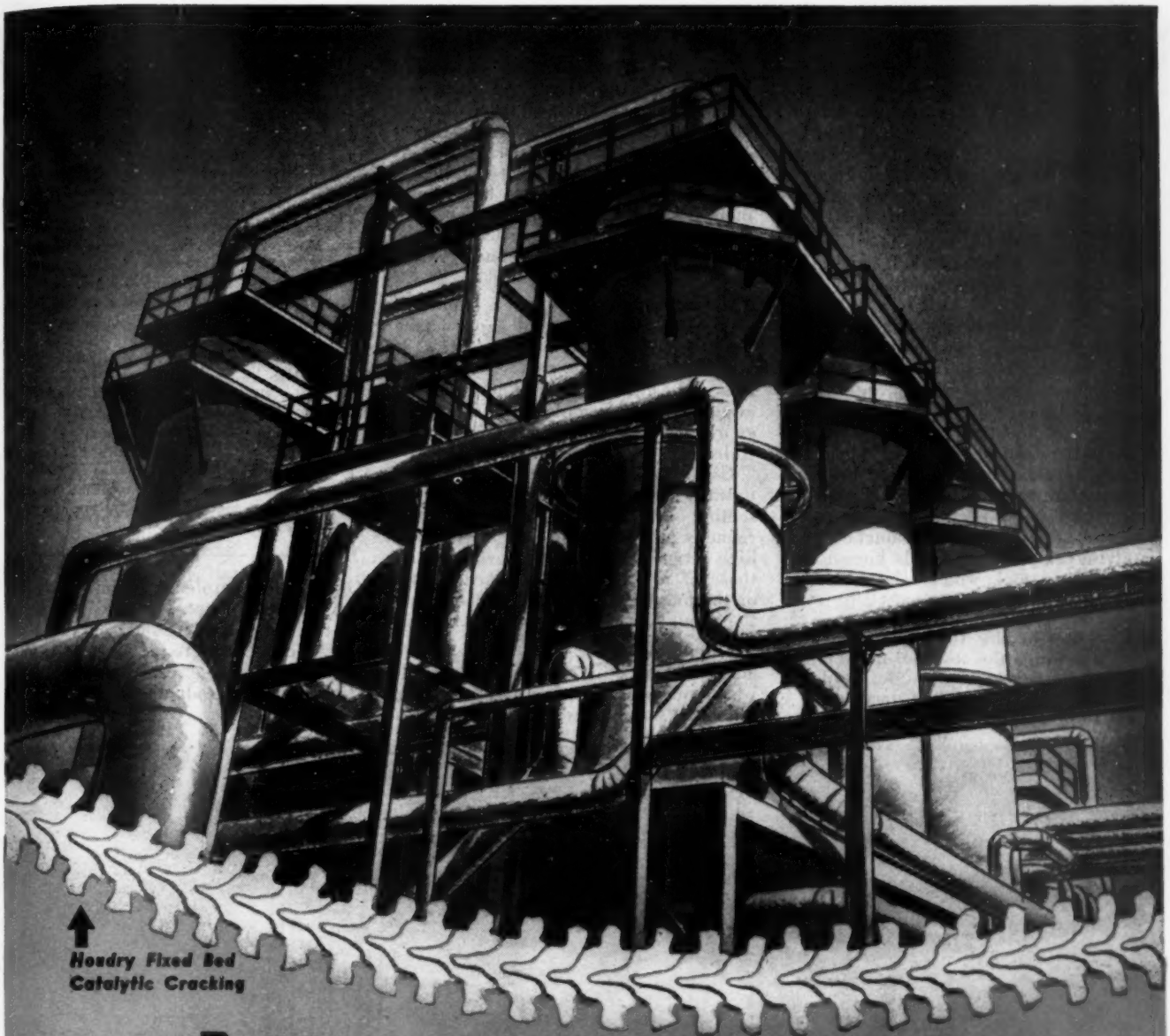


Soaring skyward and suggesting "crows nest" platforms on a battleship are these towers in the alkylation unit recently completed at Richfield's refinery near Los Angeles. Here isopentane and isobutane are combined into alkylate, the blending agent that puts long range into aviation gasoline powering the battleships of the air.

CATALYTIC CRACKING

. . . THE BACKBONE OF THE 100-OCTANE AVIATION GASOLINE PROGRAM





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BY SUPPLYING in constantly accelerating quantities the major components of 100-octane fuel, *Catalytic Cracking* has made possible the great past and present Allied aerial offensives. *Catalytic Cracking* will continue in pace with the increasing crescendo right on to V-Day! And just as surely, *Catalytic Cracking* will help in the post-war and peace economy!

Badger's part in this program covers the entire period from the world's first commercial catalytic cracking units, through the engineering improvements resulting in the current Houdry Fixed Bed Units to the latest applications in Thermofor Catalytic Cracking.

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BADGER-DESIGNED AND BADGER-BUILT UNITS HAVE PRODUCED MORE CATALYTICALLY CRACKED GASOLINE THAN ALL OTHERS COMBINED.

(Continued from Page 111)

to fit the tremendous force of fuels that can be produced with this new refinery equipment. In addition to 100-octane plus gasoline, the new refining processes at Richfield's Watson plant will enable the company quickly to produce better automobile fuel, marine fuels, diesel and lubricating oils, as well as other products derived from the refining of crude oil.

▼ **Catalytic cracking unit.** The largest of the new units installed is the thermofor catalytic cracking unit, called the cat cracker, which produces aviation base stock and finer automotive fuels.

The cat cracker transforms low quality oil vapors, blown into the catalyst chamber through the botttom into high octane gasoline.

There are 750 tons of the bead particles in the catalyst chamber. It is here that hydrocarbon molecules are broken down, rearranged, and fashioned into a new pattern of power, far superior to the best prewar gasoline. The product of this catalytic cracking process is known as aviation base stock, which is later blended with other products to meet any fuel specifications required by modern aircraft motors.

The cat cracker chamber is 20 stories high, rearing 240 ft. into the air. A special permit was obtained from Los Angeles County authorities as the height exceeded the limit imposed by law. A passenger elevator has been installed to enable maintenance crews to perform their duties quickly. Various levels of the cat cracker are connected by telephone with the Richfield refinery switch board.

▼ **Fractionation.** Another important step in the production of super-octane gasoline is the fractionation process. It is here that pure isopentane, one of the most powerful substances known, is separated from the complex mixture of other hydrocarbon compounds found in petroleum.

Giant towering structures, reaching upward for more than 150 ft. and representing one of the finest examples of the refiner's art, separate, by distillation, high octane gasoline hydrocarbons from those of low quality. The "heart cut," or the finest gasoline produced by fractionation, is used in aviation gasoline.

▼ **Cumene plant.** Then there is the cumene plant, built completely from salvaged material. Cumene is one of the refiner's "war babies"—an infant prodigy of the petroleum chemist with the strength of a giant. The story of cumene is really the story of our success in the air, because the production of this vital blending agent increased our total aviation gasoline production almost 23 per cent.

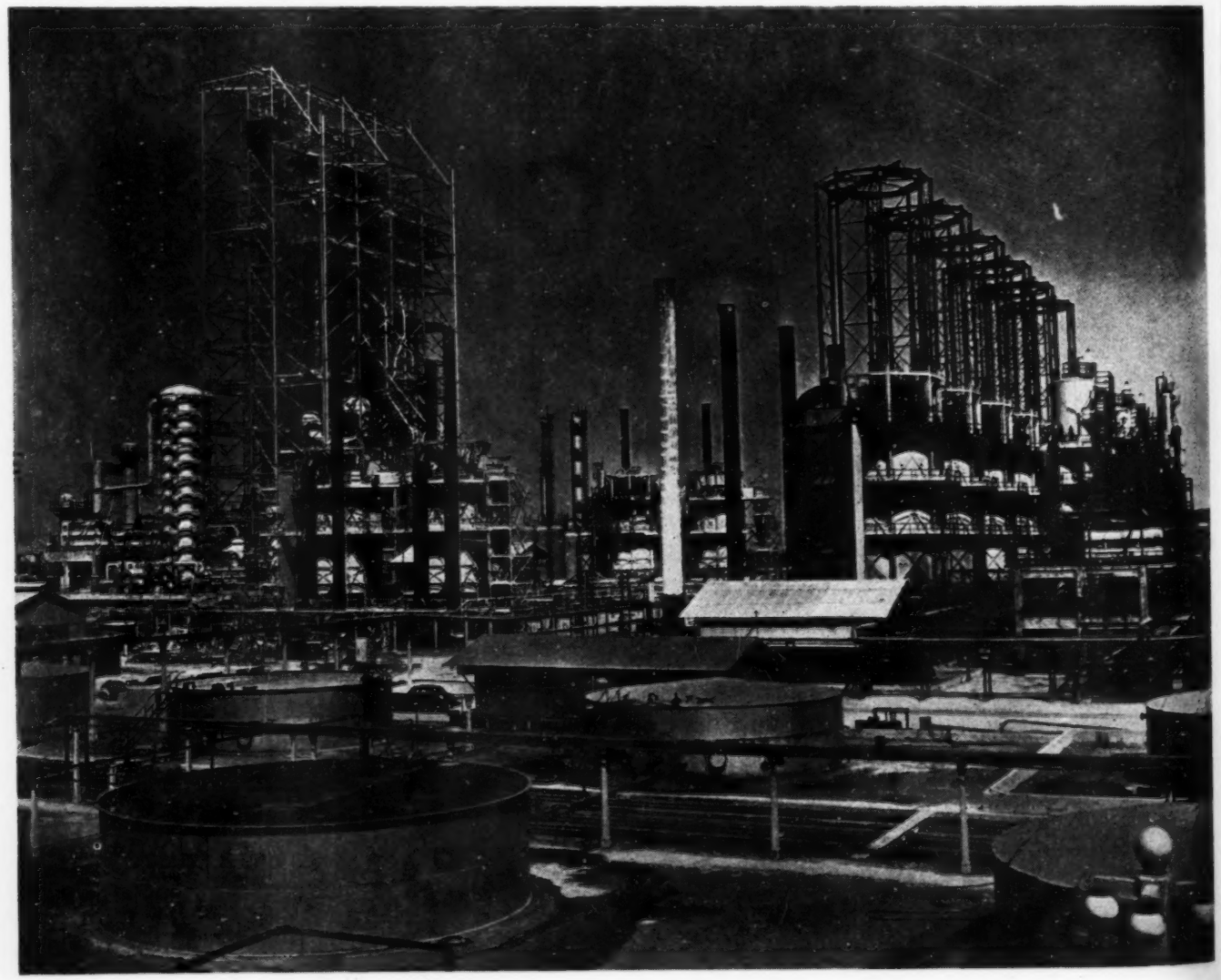
A section of the 100-plus octane refinery with the thermofor catalytic cracking unit on the left and the primary cracking furnaces on the right.

Sells Elk Hills production

Sale by the navy of approximately 2,500,000 bbl. of crude oil from the Elk Hills reserve to Union Oil Company of California, Shell Oil Company, Inc., General Petroleum Corporation of California, and Mohawk Petroleum Corporation has been approved by President Roosevelt.

Acting Secretary of Navy Ralph A. Bard executed the contracts. The oil is the estimated total production for the account of the navy from the Elk Hills naval petroleum reserve for the six months' period ending December, 1944.

Crude oil involved in the sale is the first to be produced from the reserve under the unit plan contract between the navy and Standard Oil Company of California, signed on June 19, this year. Production was authorized by Congress in June in response to an urgent military need for increased West Coast production to supply the armed forces in the Pacific.



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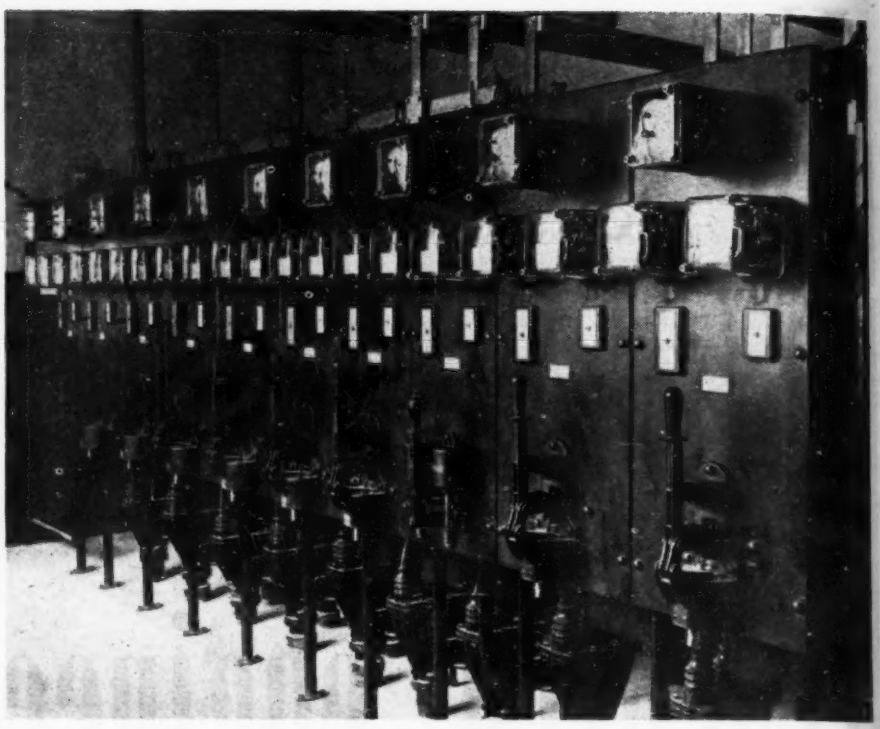
Cumene is compounded synthetically from benzene and other petroleum hydrocarbons, resulting in a concentrate of power that has enabled our refineries to bring up the power rating of lower grade gasoline to aviation specifications.

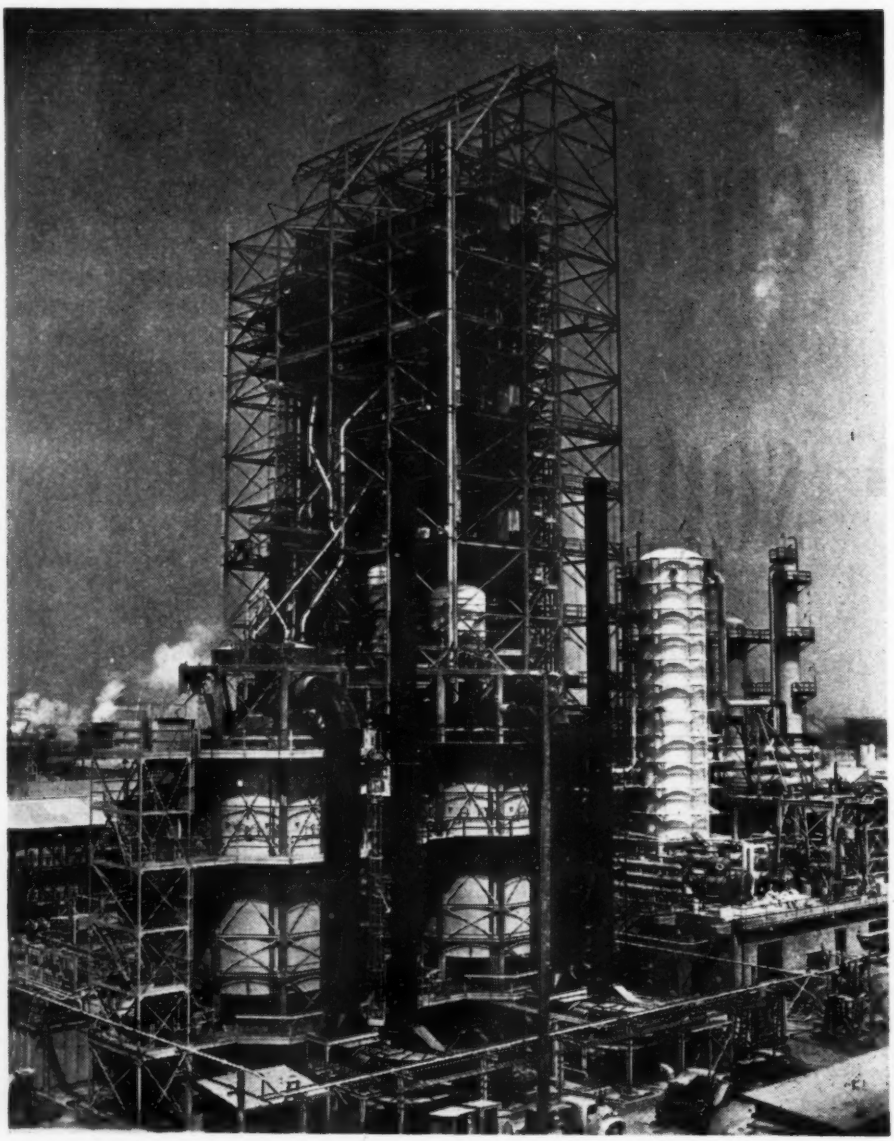
Cumene has done more than increase production. It has also increased aircraft performance. When used as a blend with high quality base stock, cumene provides superior power for take-off, climbing, and dog-fighting. It gives an extra surge of power when altitude needed in a hurry may mean life to combat pilots.

▼ **Alkylate.** Another super-fuel concentrate necessary for extra power in action is alkylate, a blending agent that has added hundreds of miles of range to bombing and fighting planes. Alkylate is also a super-fuel, too powerful for modern motors, yet an invaluable asset to the aviation base stocks produced in other refining operations.



Control panel for electrical installations in the Richfield refinery near Los Angeles.

The cat cracker, below, is one of the many units in the expanded refinery. Twenty stories in height, this structure changes low grade fuel vapor into high aviation base stock in quantity production. The huge catalyst chambers contain 750 tons of bead catalyst.



Isobutane, a product of an isomerization unit, is combined with other hydrocarbons in the presence of extreme cold and sulphuric acid to form alkylate. It is alkylate that has pushed back the barriers of distance and enabled our fliers to bomb Berlin and Japan from bases well within territory controlled by the United Nations.

Alkylate enables fliers to throttle down, permitting greater cruising range.

This new process of refining will result in many benefits in the postwar era.

Probably the most important of these will be a tremendous saving in the nation's oil reserves.

As previously pointed out, 100 per cent more gasoline is now produced than heretofore from a barrel of crude oil. This would indicate that our reserves will last twice as long as the latest reported estimates.

Industrially, the creation of superfuels opens a vast new field of expansion.

Production of higher powered gasolines will permit automotive as well as airplane engineers to design smaller and lighter power plants, which may result in radical changes in public transportation.

Marine motors, portable gasoline engines, farm power equipment, in fact, virtually everything driven by gasoline power, may be redesigned to take advantage of more powerful fuels.

In addition to a finer grade of gasoline, better and more economical diesel and lubricating oils will also be available when the war emergency is over.

★★★

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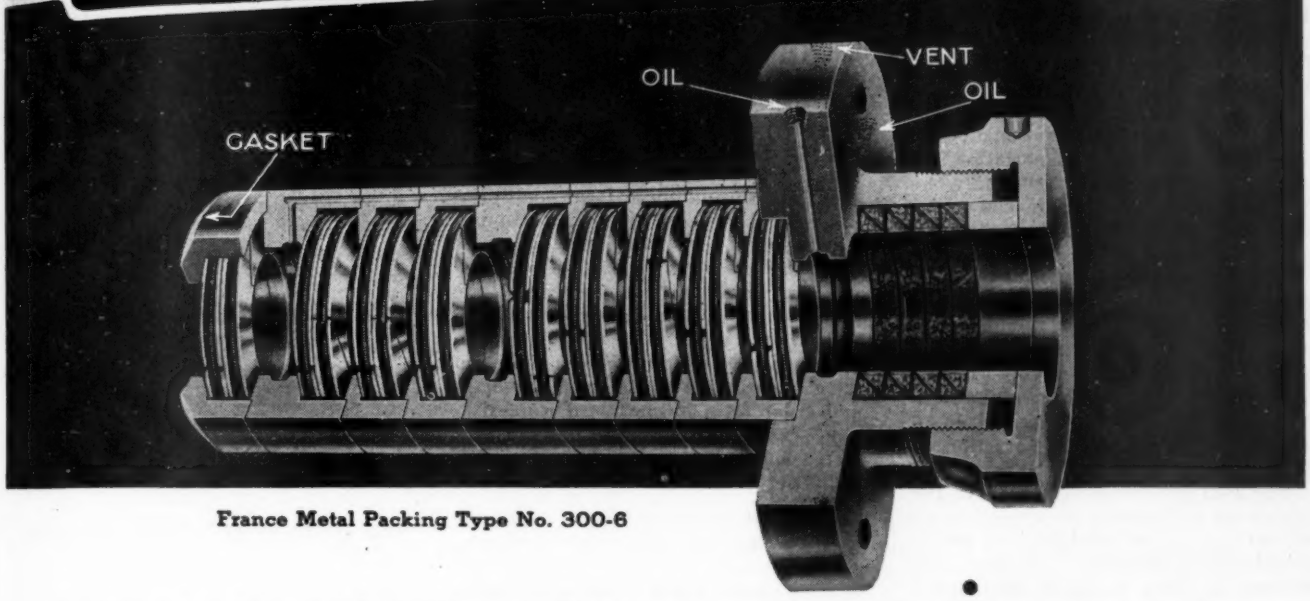

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Furnished either with or without the auxiliary stuffing box arrangement, depending on the type of gas and the operating conditions. The number of pairs of rings in the main stuffing box is governed by the pressure and operating conditions. The main stuffing box rings are made from the material which we have found from experience to be best suited for the type of gas encountered—cast iron, bronze, micarta or carbon.

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DISTILLATION and ISOMERIZATION

By R. G. LOVELL

EXCLUSIVE UNDER the stress of war demands for a high octane aviation gasoline there has been, and is, a natural tendency to emphasize those processes such as catalytic cracking, isomerization, alkylation, hydroforming, etc., that have had chiefly to do with attainment of the objective. The refining branch of the petroleum industry can and should take justifiable pride in having met and overcome the handicaps of materials and manpower shortages, congested transportation systems, etc., and that the seemingly impossible production goal has been accomplished. It is truly one of the marvels of the age.

Now, however, it is time we took stock of our situation with the idea of turning this enormous amount of equipment and capital investment into useful and profitable channels after the war. In doing this, if we bring to bear in the form of sound economic thinking and cooperative action just a small fraction of the technical ingenuity and executive energy that has been displayed in the attainment of the primary objective, we will, at least, have established a precedent. It will indeed offer a strange commentary if, after having demonstrated our control over the inanimate forces of nature, as in the thousands of hydrocarbon molecules in crude oil and natural gas, we are unable to exercise equal control over the forces of human nature, which in the last analysis make up the most important factor in our national economic welfare.

Along with the plethora of equipment comes a threatened paucity of materials. The latter condition is one that the writer frankly confesses his inability to evaluate. It was but a few years ago when many so-called authorities were predicting that our known reserves of oil and gas were "practically limitless" and that, therefore, there was no need for practicing conservation—especially if such practice seemed to threaten sacrifice of immediate profit. The apostles of conservation were freely labeled as "crackpot idealists."

We are now being told, by men with equal claim to authority, that our oil and gas are to be exhausted in from 15 to 20 years at present rates of production and use. War demands are being blamed for this reversal of viewpoint, but the actual figures are available to anyone and an inspection of them fails utterly to confirm this assertion. Some are more specific and are blaming the condition entirely on the demand for high octane ratings, stating that certain processes used in producing the base stocks are enormously wasteful of crude oil. Of course, if one were to operate a catalytic cracking plant, for example, without provision of facilities for alkylating or making other efficient use of the gases therefrom that were too high in vapor pressure to be suitable for gasoline, there would be a distinct waste of crude oil. There are many ways in which waste *can* occur, but there is no valid reason why this *must* be the case.

▼ **Significance of isomerization in the refining picture of the future.** To obtain a true concept of the importance of isomerization generally it is only necessary that one broaden his viewpoint to cover the general objective. The specific objective will vary with each individual plant and set of conditions, but, in no case, will any of these local conditions diminish the overall importance of isomerization as an implement of great value in increasing the unit value of petroleum products, not only from the angle of utility, but decidedly so from the revenue angle. The whole proposition is simply this: By conversion from the straight chain to the branched chain molecular form by means of isomerization, several of the normal paraffins are increased in octane number by as much as 50 per cent.

▼ **Value of isomerization as a process balancer.** We have gone on for years considering each refining process chiefly by itself, and without giving due thought to its effect upon, or how it was affected by, other processes, either in the same plant or in others in the same general area. This practice worked out fairly well so long as major processes were confined to straight-run distillation and thermal cracking. Losses of 1½ per cent in straight-run and 5 per cent in cracking were not considered as particularly alarming. Crude oil was plentiful and cheap and in many plants much of the loss, which was in gaseous form, was recovered as overhead from the stabilizer and used as fuel for stills and boilers. By transforming all except the noncondensibles of these gases to their liquid equivalent, crediting the crude charge and charging refinery fuel with this liquid equivalent, the yield figures looked better but the "bucks balance" took a beating, because butane-propane at a market price of 6 to 8 cents per gal. makes rather expensive fuel for process heat.

▼ **Polymerization.** Next came the polymerization process which, usually by catalysis, recovers some of this waste gas in the form of polymers. This product in itself had a high octane rating and further had that which at the time seemed to be a strange characteristic, the ability to increase the octane number of the blend in which the product was used beyond the direct proportion. Thus the expression blending value came into use. Recoveries, however, were not high and the depressed condition of the motor gasoline market at the time kept the process from attaining wide acceptance.

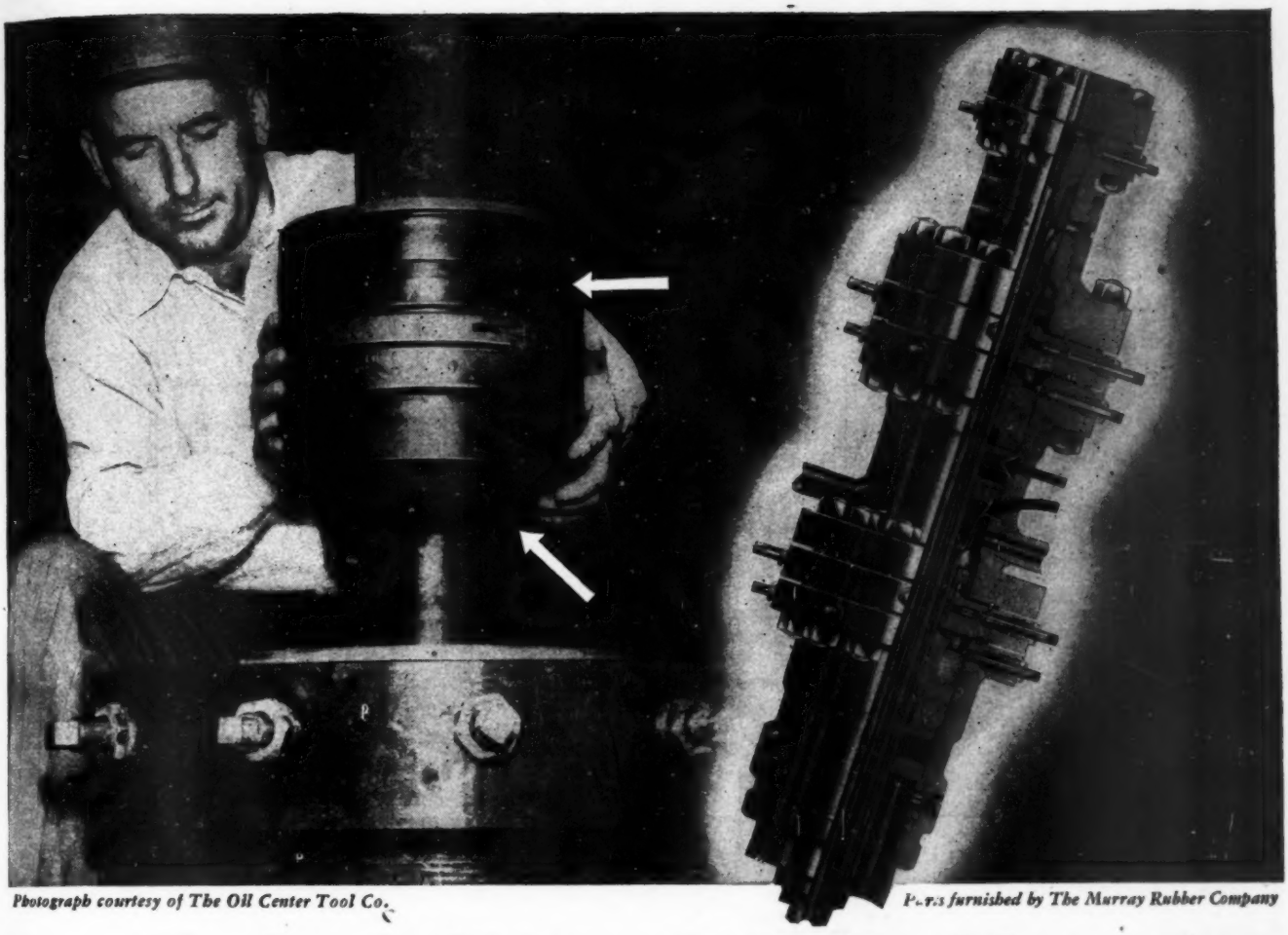
▼ **Alkylation calls for a balancing of stocks.** Then came alkylation, which proved to have enormous value in the production of 100-octane aviation gasoline. The output, however, was definitely limited by availability of charge stocks, which was a function of the amount of cracking done and the amount of isobutane that could be had from other sources. Military demands provided the incentive and catalytic cracking, unwittingly perhaps, supplied the implement by which the amount of butylenes available for the unsaturated half of the feed stock for alkylation was increased very substantially. As gases from cracking also contain varying amounts of isobutane, this helped in the balancing of the charge stocks. A more recent development that has increased the output of alkylate is the use of anhydrous hydrofluoric acid as the catalyst. Among other points of advantage claimed for the HF alkylation process is that by its use the number of forms of butylenes that can be used for charging is increased. All this demanded more isobutane for equalization with the added amount of olefins. Additional fractionating facilities for separating the isobutane from natural gas helped the situation but was not the remedy in many areas and with all companies, for some do not have under control the necessary crude production from which to draw.

"The Refinery of the Future" should consider the processes of distillation and isomerization jointly to obtain the best results.

▼ **Butane isomerization as a conservation measure.** Normal butane is usually available in ample quantity, because it is the most abundant of the 4-carbon-atoms hydrocarbons found in petroleum. It is now commercially possible and practicable, by isomerization, to convert almost all or any part of this normal butane and thus provide for the large quantities of butylenes that are available from cracking operations.

Even by the usual means of product-pump-back reflux fractionation fairly complete separation of isobutane can be made but the enormous heat losses will be enough to turn our attention to more efficient distillation and fractionation methods. Such improved methods are available and will be explained later.

The point now to be explored is the part that isomerization can and will play in the overall conservation of our irreplaceable reserves of petroleum. In such exploration we should not limit ourselves to the operations of an individual company or refinery. If we do we will be following the same selfish policy that



Photograph courtesy of The Oil Center Tool Co. *Parts furnished by The Murray Rubber Company*

Hycar Handles Multi-Zone Casing Head Separations

ONE problem in Multi-zone well production separation is in the casing head where the resilient packing material has a difficult and tricky job to do. For example, recently in several wells in one Gulf Coast field the packing material had to separate dry gas under 3800 lbs. pressure p.s.i. and high gravity distillate flowing under 3000 lbs. pressure p.s.i. To handle this difficult situation Hycar was selected by The Oil Center Tool Company for use in its "C-9-D" Casing Head. The upper arrows in the illustration point to two hinged rings of Hycar resilient packing, while the lower arrows show the Hycar stripper type packoff. Both types are constantly exposed to oil and/or gas upon the completion of a well.

Hycar was selected for this job because of its established superiority in resistance to petroleum products. Hycar is a well-known name in oil fields where its petroleum and acid-resistance, its abrasion-resistance and its high tensile strength have made it the ideal material for gate packers in mud line valves, oil well tubing packers, coal rings, packing for well heads, gaskets and many other products where these properties are vital.

Ask your supplier to furnish you parts made of Hycar for actual tests in your own applications. Learn for yourself that Hycar can help reduce operating costs—that it's wise to use Hycar where the going gets tough. *Hycar Chemical Company, Akron 8, Ohio.*

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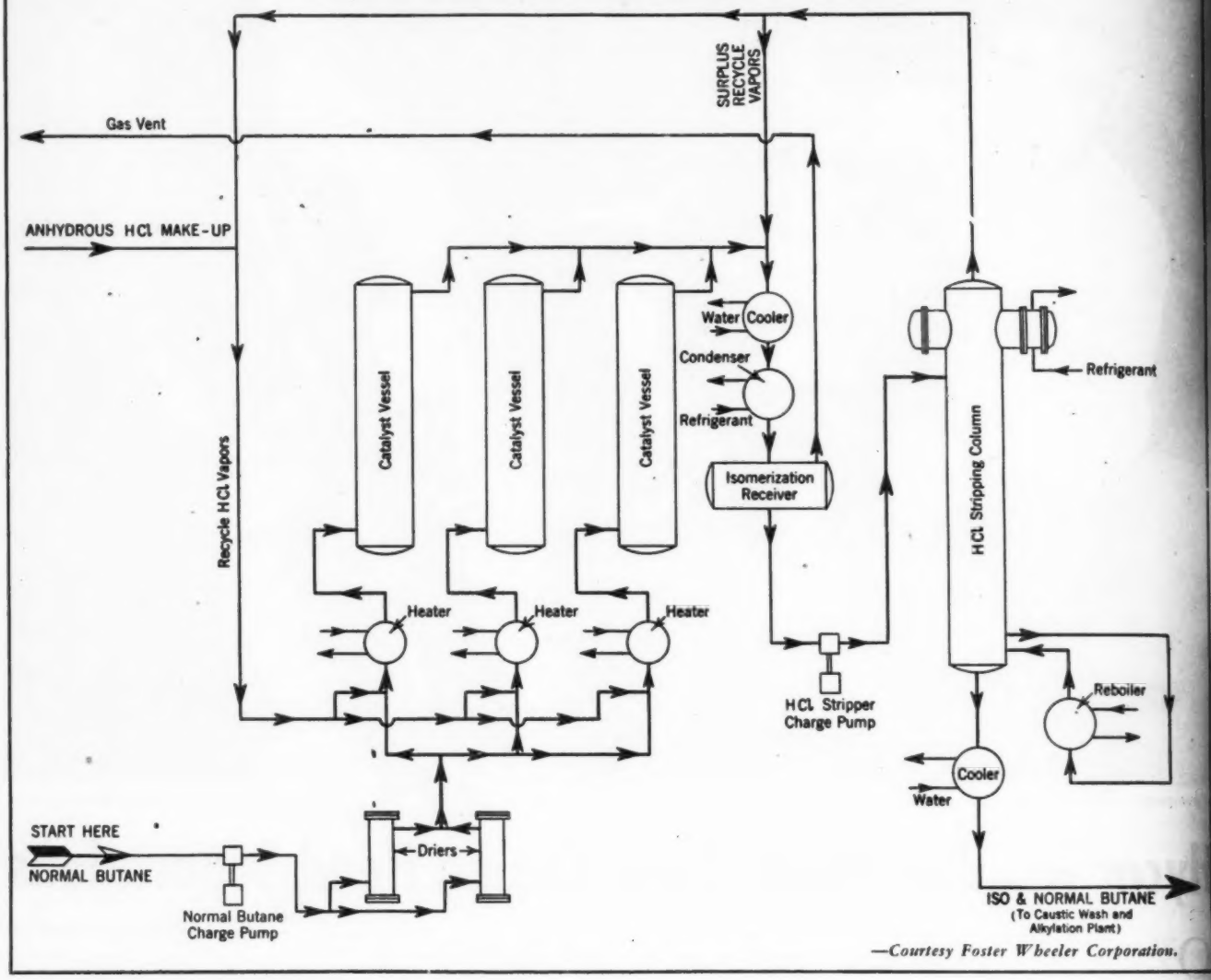
FLOW DIAGRAM OF ISOMERIZATION PROCESS



—Courtesy Foster Wheeler Corporation.

has heretofore been found unsound simply because its primary objective was a selfish one. In face of the knowledge that our reserves of petroleum, whatever may be their total, are irreplaceable and their recovery becomes increasingly more costly, we still find some who insist upon limiting study of conservation to the conditions surrounding the operations of individual companies. Such a viewpoint is understandable but nonetheless inexcusable. Only by cooperation between units operating in any one area can true conservation be achieved. For instance, one company may have been fortunate or farsighted enough to have acquired large crude production volume in some field. This naturally involves the production of an equally great volume of wet gas. Suppose now there is a market for the methane-ethane content of this gas as household and industrial fuel, and that the company's motor gasoline market can absorb some portion (usually relatively small) of the butanes. This leaves the propane and the greater part of the butanes to be disposed of as bottled gas, or otherwise. A situation such as this, which is by no means unusual or exaggerated, leads inevitably to the inclusion of isobutane in the container gas. At the same time this is taking place other refineries in the same field may be finding it necessary to resort to isomerization to obtain sufficient paraffinic material to balance the olefins from their cracking operations for charging to alkylation. The latter plants, usually with inadequate supplies of owned or controlled oil and gas, have naturally emphasized catalytic cracking in their processing scheme in order to obtain sufficient base stock for aviation gasoline and for the higher octane motor gasoline certain to be in demand after the war for automotive use. Admittedly, the production of considerable quantities of gases is a concomitant of cracking, but if efficient use of the gases is made, such as alkylating them, there is no particular waste of raw material. Much of the wailing and gnashing of teeth over the so-called waste of crude oil in producing high octane gasoline will be found to be based upon the supposition that full use of the gas is not made.

It is a weird type of economic thinking indeed that predicates its concept of economic use of petroleum upon the idea of maximum recovery of salable products from a unit of raw material without regard for the utilitarian value and consequent selling price of the products. We may depend upon it that the American people are going to demand of the automobile manufacturers cars that will utilize to the fullest advantage already developed fuels much more powerful than those we have had in the past. These are not "dream" fuels; they are realities, but certainly they will

—POSTWAR PLANNING—

"As regards the oil companies, conversion from war-time to peace-time operation will not be nearly as difficult. This is true principally because we have continued, during the war period, the making of petroleum products of the same character which we were turning out before the war, and of the same types as will be in use after the war. It is true that some new war-born materials are now in tremendous production, but we are still making our old "stand-bys"—lubricating oils, gasolines, heavier fuels, asphalts, and various specialties.

"And so it is apparent that as far as manufacturing is concerned, we can, by making some relatively easy adjustments, revert to peace-time production with little or no dislocation or confusion."

F. W. Barton, president,
Lion Oil Refining Company

ONE OF THE *FINEST RECORDS* IN THE INDUSTRY...

CLARK 300 H. P. Angles, part of refrigeration system at alkylate reactors, have capacity of 150,000 cu. ft. of gas per hour, at 14.7 lbs.

Here's another fine record for continuous operation!

Mr. H. W. Camp, manager of the Refining Division of Cities Service Oil Company, writes us of these CLARK'S in their East Chicago refinery: "These compressors are a vital part of the alkylation unit, and both compressors must be in operation continuously, to maintain the maximum rate of alkylate production. The combined alkylation and isomerization unit at East Chicago has, from reports received, one of the finest records in the industry for continuity of operation, rate of production above design figures, and quality of production."

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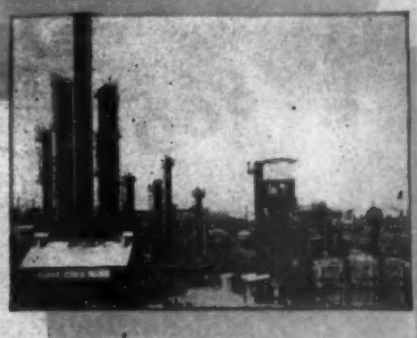

be more costly to produce. Equally weird is the reasoning behind a recently publicized "new discovery" that motor fuel could be made from natural gas, or that we could copy a wartime European practice and use the gas "as is" to power our cars. The obvious inference was that because of this "new discovery" we need have little concern over the conservation of gasoline. The byline on the story was that of a prominent scientist, but he failed to provide in his prediction for the gas that was to supply our present and valuable uses for dry gas after he had taken it for his gasoline manufacture.

▼ How cooperative operation of isomerization facilities will help in conservation. No one will deny the fact that the inequalities of control of crude oil and gas production, pipe line and refining facilities and market outlets are natural and inevitable and also that the condition does not lend to efficient use of the raw materials, their separate hydrocarbons or groups thereof. What, then, can be done to attain the dual objective of efficient utilization and adequate return on investment and contribution of all concerned? Certainly the writer with a background of more than 40 years of reasonably successful and mutually satisfactory service to corporations does not advocate the application of any political isms or any Utopian-economic theories to the problem. The result would be further confusion through the effort to substitute basic theory for proved practice. Nor is there any support for the frequently expressed notion that cooperative effort by oil companies would, necessarily, run afoul of the anti-trust laws. The purpose of these laws is clearly expressed in the wording used—to prohibit combinations in restraint of trade. Assuredly, a combination of the resources of several oil companies, which results in most efficient use of a natural resource and a reasonable and fair profit to the companies, cannot be said to be in restraint of trade.

—POSTWAR PLANNING—

"The nation, and we as individuals, must realize that we can live only as we exchange our products with customers and the customers must have something to exchange.

"We must be free customers, men and women who can go to market place and buy or not buy exactly as we wish. . . . If government offices can dictate our lives as customers, they will be compelled to dictate our lives as producers, which means we shall work where, when and at what wage the bureaucrats order.

"Even before the war is finished, we should drop regulations no longer necessary for war purposes."

Willard H. Dow, president, The Dow Chemical Company

▼ Technical and physical aspects of cooperative facilities for wet gas processing. As our present discussion is confined chiefly to the preliminary processing of the crude petroleum and the recovery of the products of the wet natural gas, only those phases of refining will be considered. It is in this step in the overall picture that the advantages of cooperative action seem to indicate common processing facilities more than in the succeeding operations.

It is not contended that these preliminary operations are particularly more efficient when carried on in a large plant than in a small one. The greater efficiency lies almost entirely in the fact that the large plant can absorb the inevitable peaks and valleys of demand for the various products of the plant by the participating organizations and, what is equally important, can insure 100 per cent load factor for the pipe line distributing the various products. The discerning oil man will also realize that his rather loose methods of line wash and use of a common line for several products will not fit into the refining picture of tomorrow. It simply does not make technical sense to isomerize and fractionate closely to satisfy market demand and in the interest of conservation, then proceed to contaminate the products by permitting them to commingle in a pipe line. Nor does it make sense to freeze capital in the construction of pipe lines for each product, which lines may not actually be transporting oil for more than a fraction of the time. In any case such lines with low load factor would naturally be built as cheaply as possible because of the low return on the investment, whereas if they are

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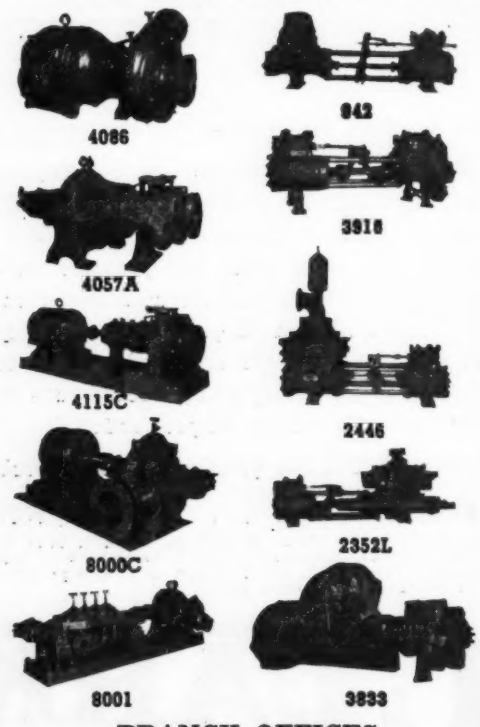

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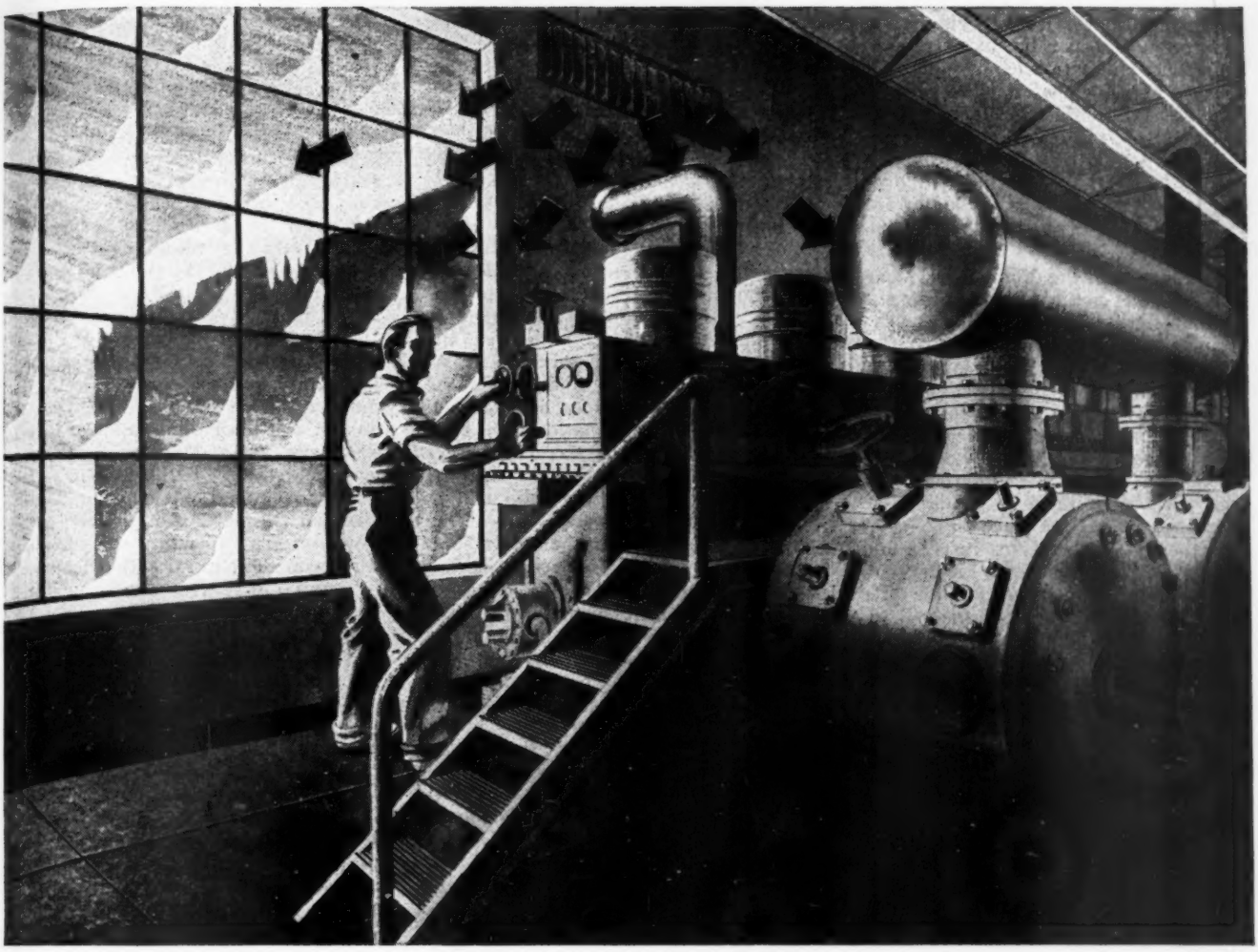
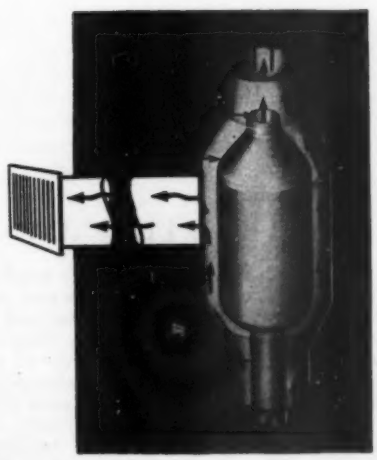


Turns winter into summer!

Here's a simple, inexpensive way to heat your engine rooms in cold weather... as well as to keep them cool in summer.

The average velocity of flow in the air jacket of the standard FLUOR Air-Cooled Muffler ranges from 1,500 to 3,000 feet per minute. This air is heated by contact with the muffling chamber, thus acting as a heat exchanger. A heat economizer, installed in the side of the air jacket below the exhaust gas ejector cone, provides an efficient method of heating the engine room and precludes the necessity and expense of providing auxiliary heating equipment. In warm weather, a damper shuts off the heat and the positive ventilation provided by the FLUOR Air-Cooled Muffler helps to keep the room cool.



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in cooperative service with high load factor, the cost per barrel of product handled declines to such a point that the cost of using material that will assure long and trouble free operation will be entirely warranted. There can be no economic justification for the use of public highways for transporting crude oil or any of its products when better and certainly safer methods can be made available.

Segregation of the different hydrocarbons in a wet natural gas according to their utilization characteristics involves problems of measurement in a cooperative plant that would not be of particular importance in a single company plant. For instance both isobutane and isopentane would take higher value than their normal forms, which would then be charged with isomerization costs for such portions of them as would be so processed. It will at once be obvious that these isomerized products would find a ready market with other companies that were without facilities for this process. Spectroscopic analysis offers a relatively simple and sufficiently accurate means of recording proportions of each of the hydrocarbons in the gaseous charge stock from each contributing unit. This could be coordinated with volume recording instruments to determine quantities of each constituent, thus assuring each participating company its fair and equitable return for both quantity and quality of feed stock supplied. All in all, the cooperative idea seems to offer the only sure way of making fullest and fairest use of one of our irreplaceable natural resources.

In closing this section of our discussion one should not neglect what is perhaps the most pertinent of all the reasons in favor of a large volume plant for preliminery processing: the cost of building a full size and complete plant per barrel of throughput is only a fraction of that of a small plant.

▼ **General description of the isomerization process.** An encyclopedic definition of isomerization is of little value to the practical man. He is chiefly interested in the potentialities of the process and how they can be applied advantageously in his own set of conditions. Isomerization generally ranks in importance with catalytic cracking, alkylation, and other recently developed processes.

There is no essential difference between methods involved in the isomerization of various hydrocarbons. The difference lies chiefly in the availability of the normal form of the hydrocarbon and the nature and amount of use that is to be made of the isomers. Efficiency of the process decreases somewhat with higher boiling point stocks. It must be kept in mind, however, that fractionation is an essential step in the isomerizing process and that the differential between the boiling points of the normal and iso forms determines the difficulty of the fractionation. Fortunately, new and better methods of fractionation have been developed along with the many other improved refining techniques and the slight differential between the boiling points—something like 16° F.—of the normal and iso forms of the two presently most commonly isomerized hydrocarbons, butane and pentane, offers no great problem. Development of the alkylation process necessitated a solution of the major problem and the solution brought into use a new fractionating implement, refrigeration.

▼ **Application to various conditions.** The significance of isomerization to any individual company can best be illustrated by setting up a few hypothetical situations. Suppose, for example, that a company has substantial crude and natural gas production but has meager refining facilities that do not include cracking. As there is no cracking, there are no olefin bearing gases to be salvaged for their high octane value, either by polymerization or by alkylation. Therefore, there is no point in transforming the assumed large amounts of normal butane to the iso form. The difference in octane number between isobutane and normal butane is only 7 numbers, which in the case in point would hardly warrant even their separation by fractionation, because the amount of butane demanded for volatility correction of the straight-run gasoline would be small. Isobutane would, of course, command a premium price for alkylation feed stock, but to make the transformation from normal to iso form at point of crude production would not be economical for reasons of transportation complications. The normal component would have equal value with the isobutane, less isomerization charges. Remember that the production company was said to be without cracking facilities and consider, therefore, that in order to be competitive in the motor gasoline market, some other means would be required to boost the octane rating of its straight-run product. Use of butane for the purpose is naturally limited by volatility specifications. However, one of the components of the natural gas production is pentane, both in normal and iso forms. The octane numbers of the two respectively are 89 and 61 and the boiling point of isopentane is 82° F. at atmospheric pressure compared to 14° F. for isobutane and 31° F. for normal butane. This wide differential permits a much greater use of isopentane as a blending agent for volatility with the natural consequence of a substantial increase in octane number of the completed blend.

The other side of the picture would be presented by a company with crude production insufficient for its refinery charging stock to supply the market demand for aviation and motor gasoline. This condition dictates maximum recovery of gasoline from a barrel of crude, which would mean emphasis on cracking. Cracking in volume, of course, makes alkylation virtually a must, but leaves the alkylation unit definitely short of isobutane to balance the olefins from the high volume cracking. This condition makes the second company the logical purchaser of the butane from the first. It would be able also to make greater use of the normal form than the first company, because in scraping the barrel for butylenes the pressure distillate would be almost completely debutanized with a resultant Reid vapor pressure sometimes as low as 3 or 4 lb. The P. D. could absorb liberal amounts of butane to restore vapor pressure to specification of perhaps 9 R.V.P. and, because the octane number of the pressure distillate would be higher than that of a straight-run of like boiling range, the light blending stock could be the normal form of butane and still maintain motor gasoline standards. In a plant such as the one described the isobutane requirements for alkylation would probably be greater than the normal proportion in refinery gases and reasonable outside purchases of natural gasoline and butane isomerization is definitely indicated.

Pentane isomerization, on the other hand, is generally not required under the foregoing conditions. Isopentane can be used only in limited amounts in an aviation gasoline blend because of lower pressure specification, currently 7 lb. R.v.p., and there is usually plenty to be fractionated out of natural gasoline. The pentane component of many natural gasolines is composed of as high as 50 per cent of the branched chain

POSTWAR PLANNING

"Oil-producing states and their regulatory bodies must get busy immediately to regain and assume state control as soon as the war ends. Conservation of oil and gas is properly a function of the states and Texas has long recognized this. Texas and other oil-producing states will have many conservation problems to meet. We want to be ready to start work immediately on conservation and building up our depleted reservoirs by exercising our regulatory rights to that end. We do not want our handling of these problems to be delayed or impaired by any federal agency.

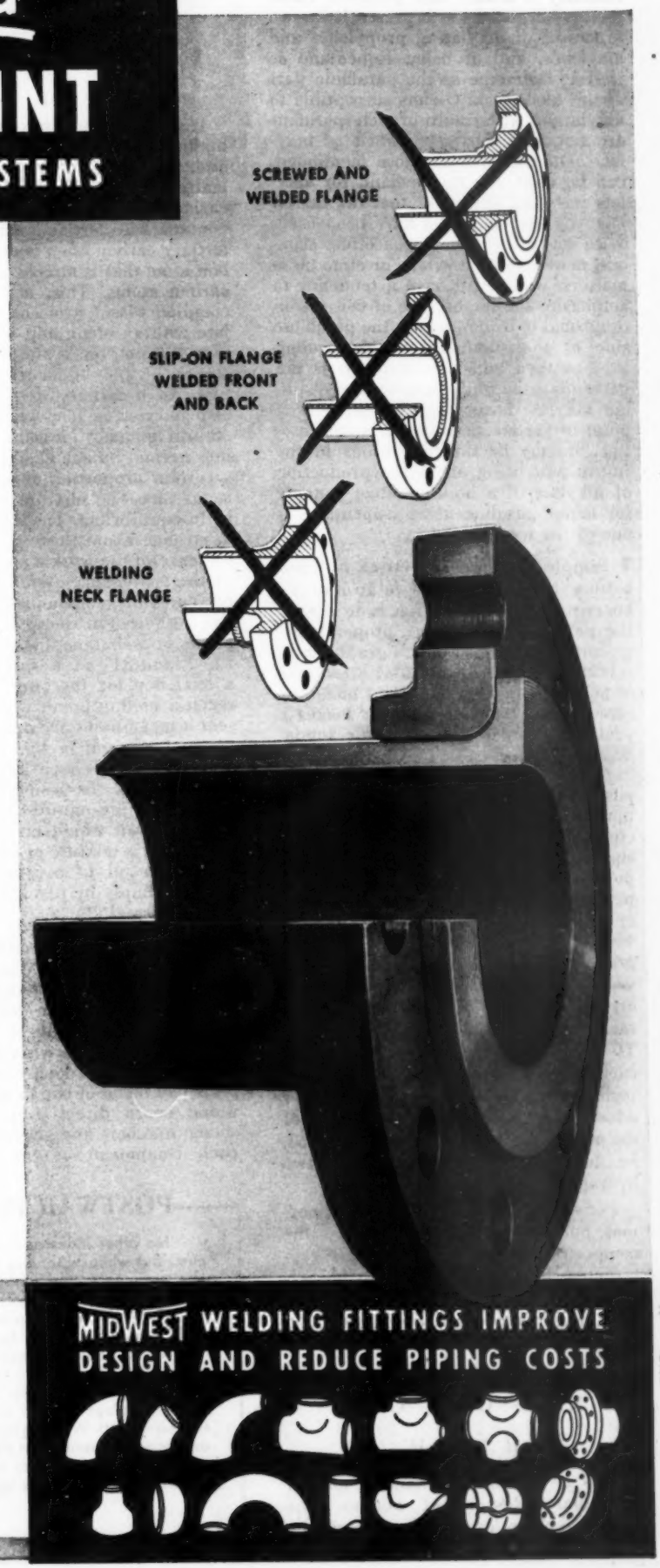
"If there are to be any requirements made of Texas or other oil-producing states by the PAW or any other federal agency before it returns control of oil and gas to the state, these requirements should be made known immediately in order that they may be studied, appraised and satisfied before the end of the war.

"1. The intention of the Texas Railroad Commission immediately upon the termination of the war to resume the entire regulation and conservation of oil and gas in Texas under statutory authority given it by the State of Texas.

"2. The willingness of the Texas Commission to cooperate with the administrator of PAW to liquidate that agency and assist in the relinquishment of its administrative regulation of oil and gas as in all oil-producing states after the war."

Beauford H. Jester, chairman, Texas Railroad Commission, in letter to Petroleum Administrator for War, Harold L. Ickes

THE Preferred FLANGED JOINT
FOR WELDED PIPING SYSTEMS



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For making connections to boilers, pumps, valves and other flanged outlets (and where piping must be frequently cleaned or inspected for corrosion), Midwest Lap-Joint Stub Ends have a tremendous advantage over flanges that are welded to the pipe (see drawings at right above). The swivel flange on the Stub End makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding.

Another important economy is in erection. Field organizations report a saving of 25% in erection time for making up a joint using Midwest Lap-Joint Stub Ends in comparison with flanges rigidly fixed to the pipe; this saving is even greater when the flanges are on bends.

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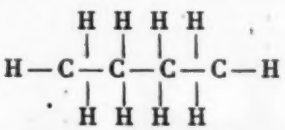
MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS

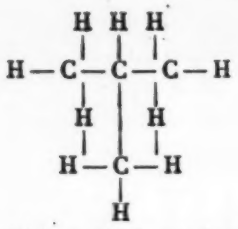
form. There are two other factors that are likely to have a profound effect upon the significance of isomerization, particularly of butane and pentane. These factors have to do with presently known processes of alkylating propylenes and amylenes, and of using isopentane as well as isobutane as the paraffinic part of the feed stock. Olefins susceptible to alkylation with multi-branch paraffins are not, necessarily, confined to butylene. Others, such as those mentioned, can be used, but the demand for alkylate has been so urgent that the easiest methods and materials have been used. With return to normal peacetime economy more attention will be given to these matters, which will have a tendency to emphasize the importance of conversion of normal to isobutane. To the paraffinic side of the suitable-materials-account, we can then add isopentane. It is not currently used, only because the resultant alkylate is too high in end boiling point to permit its use in aviation gasoline. It may be that conditions in the future will bring about the production of alkylate of a boiling range suitable for motor gasoline using isopentane as one of the feed stocks.

▼ **Simple chemical aspects of isomerization.** The only reason we go into the chemistry of isomerization is to clarify the picture by supplying proper background. The chemist makes graphic representation of the molecular structures of petroleum hydrocarbons for much the same reason that an engineer makes a preliminary sketch showing the fundamentals of an idea he may be endeavoring to work out so that a specific purpose can be accomplished. We will use that method better to illustrate the principle of isomerization. It is a phenomenon characteristic of many organic compounds, including those occurring in petroleum, which have the same percentage composition and molecular weight, yet exhibit different physical properties. These compounds are called isomers and the different physical properties are due to differences in the arrangement of the atoms in the molecule. The percentage composition of a hydrocarbon molecule before it has been subjected to conditions that have either added to or subtracted from either of the number of atoms is always the same, i.e., for each carbon atom there are two hydrogen atoms, plus two.

For example, the two substances, normal butane and isobutane, have the composition and molecular weight represented by C_4H_{10}. Two possible arrangements of the atoms in this molecule can be made and are represented thus:



This is the straight-chain or normal molecular structure of butane. The branched-chain or iso form would be shown thus:



It should be noted in passing that isobutane contains one tertiary carbon atom and, therefore, tends to enter into chemical reaction more easily than a hydrocarbon, such as normal butane, which contains no tertiary carbon atom. A tertiary carbon atom is defined as a carbon atom that is attached to three other carbon atoms. This, in itself, is not a complete reason why isobutane will alkylate with an olefin and why normal butane will not, but is simply a further instance of the enhanced chemical activity of a tertiary carbon atom. It is also interesting to note that there is a natural tendency for isobutane to change into normal butane and vice versa, until a certain proportion of each compound is present. The mixture is then said to be in equilibrium. There is nothing new or strange about this; it is just another evidence of the workings of certain laws of thermodynamics dealing with vapor pressures of compounds of like nature. The differential between the boiling points of isobutane and normal butane, 14° F and 31° F., is sufficient to cause a tendency for the two compounds to reach a boiling point, which will represent a mean point according to the proportions of each in the mixture; however, let no one hope to dispense with some part of the isomerization equipment by letting nature do a part of the job. The wait would be something like waiting for a mixture of natural gas and absorption oil to become a saturated mixture simply by placing them in contact in a vessel.

▼ **Octane number blending values of hydrocarbons.** We have become accustomed by years of practice to thinking of octane numbers in terms of group fractions of oil. As there was no warrant for doing otherwise, we have considered that the octane number of a projected blend of two or more fractions would be in direct proportion to the octane numbers and volume amounts of each component of the blend. True enough, the results were not always accurate but the market did not demand extreme accuracy so it made no particular difference. With the advent of the alkylation process, the product of which was in reality a pseudo isooctane, it was soon found that the alkylate had the peculiar property of raising the octane number of a blend in which it was used to a point beyond the figure calculated by using direct proportion. This stimulated further research, which resulted in the discovery that certain single hydrocarbons of branched-chain type had an octane number blending value considerably beyond their own rating. This property is especially noticeable in the cyclopentanes and cyclohexanes. The following table gives an idea of some of the spreads between actual and potential value.

	Clear octane number	Blending octane number
Isopentane	90.3	103.5
Cyclopentane	85.0	141.0
Methyl cyclopentane	80.0	99.0
Cyclohexane	78.6	97.0

Table from paper by A. H. Boultbee of the Shell Oil Company, Inc., delivered before meeting of California Natural Gasoline Association, Los Angeles, November 5, 1943.

This topic has been discussed under isomerization because this process is a full partner with precise fractionation in the production of these high-blending value hydrocarbons.

▼ **Historical background of isomerization and other processes.** Our very accomplished writers of fiction seem to find much of mystery and romance in the "discovery of new and revolutionary" methods of refining petroleum, but there is little of romance or even mystery for those of us who are simply in there doing the spade work. Truth compels the admission that most of our research and development amounts to shaping a few fundamental processes into implements of increased value. This seems to be especially true of isomerization and catalytic cracking, which processes are basically different only in nature of feed stocks and the consequently different levels of time, temperature, and pressure.

Strangely enough, both processes had their origin in research and development work for finding a means to reduce

(Continued on Page 130)

POSTWAR PLANNING

"No other industry contributed more to the success of the war effort than petroleum. But while other big business enterprises engaged in production of products for war are confronted with serious problems relating to reconversion to peace time operations, the oil industry is singularly free from such worries at this time. There is no reason why the petroleum industry cannot continue business on an even keel and with reasonable profits for a long period after the close of hostilities.

"Much depends upon the attitude of the federal government towards the oil business. If Washington officials take a realistic view of oil industry conditions and are willing to cooperate, oil companies can continue operations at a high level, increase employment and provide jobs at good salaries for all employees who entered the service. If Washington bureaus, created as a result of the war emergency, insist on becoming permanent fixtures and seek to maintain powers and authority delegated to or assumed by them, there might easily develop in the oil industry operations a lag which would have a widespread effect on general business conditions."

Andrew Rowley, oil editor,
Tulsa (Oklahoma) Tribune

KARBATE Trade Mark PIPES, TUBES, FITTINGS

Withstand Virtually All Corrosive Chemicals

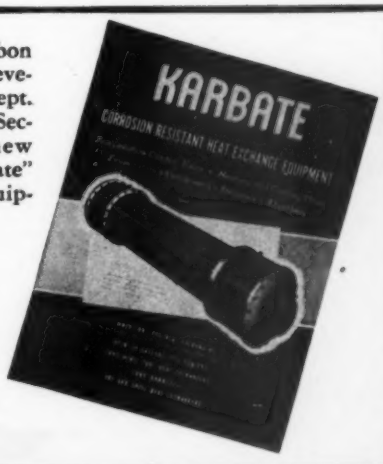
Can Be Assembled to Any Plan

PIPE, TUBES, FITTINGS, made of "National" carbon and graphite, or of "Karbate" materials (carbon or graphite made impervious to fluid seepage under pressure) are available in standard sizes for the chemical and process industries wherever corrosion problems exist.

These products, plus "Karbate" centrifugal pumps, Globe and Saunders valves, and heat exchangers, are fabricated into complete conveying and heat-transfer systems of practically any design.

This is because only "Karbate" materials have all these properties: High resistance to the action of most acids . . . notably hydrofluoric acid . . . and of alkalies and other corrosive chemicals; high mechanical strength, light weight, resistance to thermal shock, good machineability, and thermal conductivity exceeding that of many metals.

Write National Carbon Company, Inc., Cleveland 1, Ohio, Dept. 31-I, for Catalog Section M-8802—a new bulletin on "Karbate" Heat Exchange Equipment.



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Metering

extremely sour gas

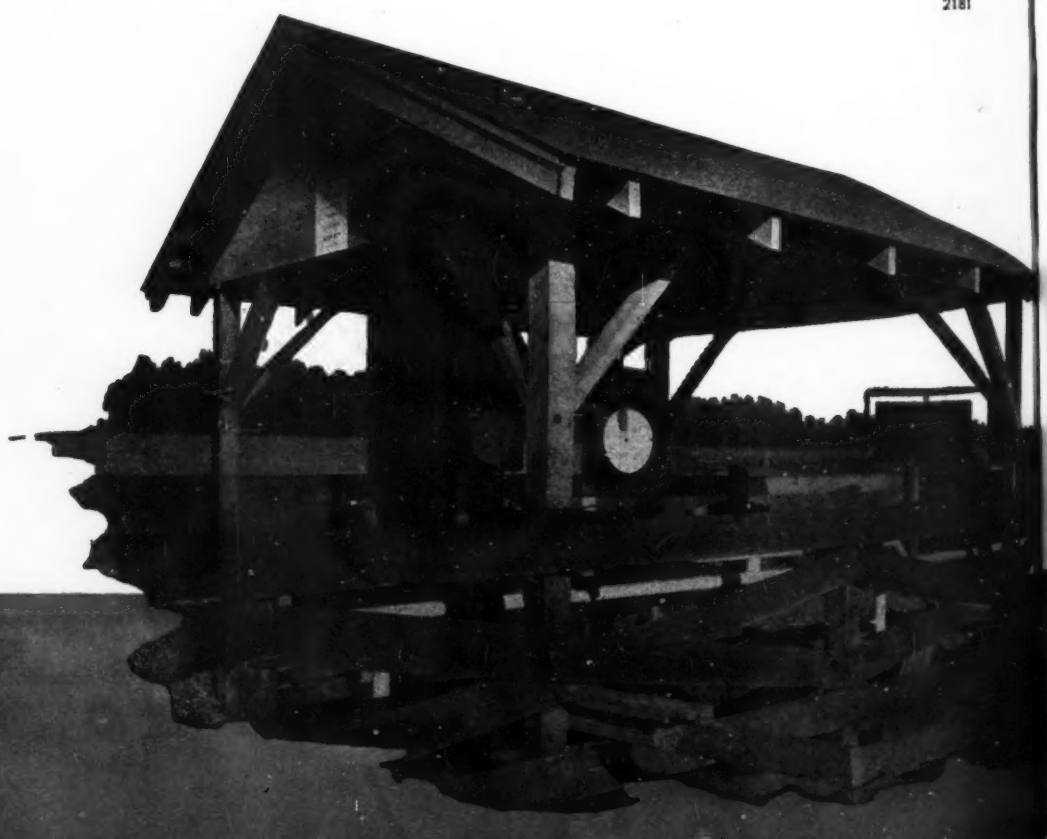
YOU'VE SEEN prettier pictures of orifice meter installations...We doubt whether you have seen tougher meter assignments.

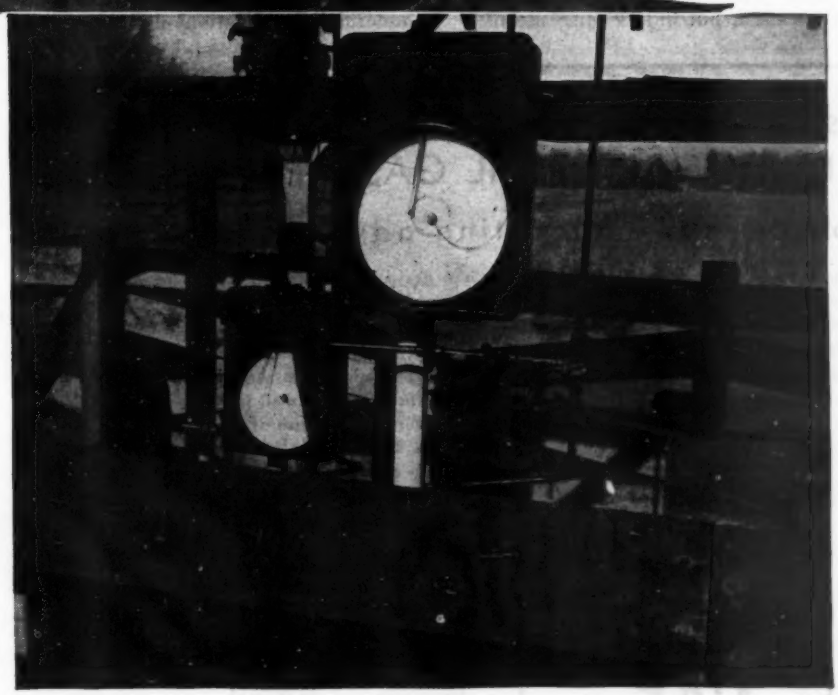
In freezing winter and in the heat of Arkansas summer, these rugged meters are measuring sour gas having as much as 4400 grains of sulphur to each 1000 cubic feet of gas. Also, the gas contains condensate, so hydrate conditions must be overcome.

As you see, these meters are equipped with kerosene-filled seal chambers to prevent reaction with the mercury, or corrosion of the mercury chambers and internal parts of the meters. Otherwise it is the standard AMERICAN instrument which around the globe is known for its simplicity of design and operation, and ease of adjustment...Only one moving part between mercury surface and chart record. (And quick cleaning is effected without interfering with adjustment.)

Specifications and operating data on this line of instruments will be sent you on request.

2181





Illustrations show three views of **AMERICAN** *orifice meters measuring sour gas...McKamie Gas Cleaning Company, Magnolia, Arkansas.*

AMERICAN METER COMPANY

INCORPORATED (ESTABLISHED 1836)

METRIC METAL WORKS • ERIE 2, PA.

POSTWAR PLANNING

"The Texas Company intends to go far beyond its legal obligations in placing men and women who return to company service from military leaves of absence.

"In placing physically handicapped war veterans, the company's policy will be to endeavor in all possible ways to find positions in which they can work and feel a sense of worthwhile accomplishment.

"Many of our employees will return with newly acquired skills and with greater educational accomplishments and will have developed greater ability to assume responsibility and to exercise supervision. Such employees should be offered an opportunity to use their education and skill to the fullest.

"Each department will endeavor to place its own returning employees, but when an appropriate position is not available in that department, or the veteran indicates a preference for work in some other department, the department head will contact other department heads in an effort to place the veteran most advantageously.

"To help department heads in this work, the company is setting up an employee counselor plan to acquaint the employee with the opportunities for educational and vocational training available to him through federal and other agencies and generally assist him in making a smooth and constructive transition from military to civilian life.

"More than 5,000 men and women employees of the Texas Company and domestic subsidiaries are serving with the armed forces."

Harry T. Klein, president,
The Texas Company

(Continued from Page 126)

sulphur content in gasoline and pressure distillate, which would give better and more economical results than the conventional method of employing sulphuric acid and neutralizing agents. There was no question of the effectiveness of the method, insofar as reduction of sulphur compounds was concerned, if sufficient acid were used, but unless some means were used to control the temperature of the exothermic heat of reaction, the octane number of the treated product was usually several numbers below the raw material before treatment, which, of course, was a highly undesirable condition. Market price of motor gasoline seldom warranted employing cooling equipment to control the heat of reaction and commercial specifications did not make it necessary anyway. Further we demonstrated our salesmanship in selling ourselves on the idea that sulphur compounds in gasoline had no particularly bad effect upon the engine of an automobile and that, therefore, there was no valid reason for their reduction below a given percentage, generally about 0.25 per cent. Many of the arguments advanced, although theoretical, were sound, and dangerous or controversial ground was sedulously avoided. It has been common knowledge for years that the presence of sulphur compounds increased the amount of tetraethyl lead necessary to raise octane number to a given point, but it did not make sense to pay the high cost for acid and for disposal of the sludge with the objective of extreme reduction of sulphur only to find that the clear octane number of the stock had suffered heavily in the operation. Perhaps because federal government purchasing agencies specified a maximum sulphur content of 0.10 per cent, this came to be considered as the irreducible minimum and that 0.25 per cent represented a good commercial figure that stood for a fair balance between all factors, including cost of tetraethyl lead.

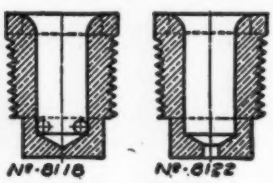
Some time back the writer conducted a laboratory investigation aimed at developing the lead susceptibility of various blends of cracked gasoline as well as full cracked stocks, when the reaction heat was dissipated as formed and by the use of liberal amounts of spent alkylation acid of approximately 87 per cent strength. The result showed very

Distinctive Design Features of NATIONAL AIROIL GAS TIPS

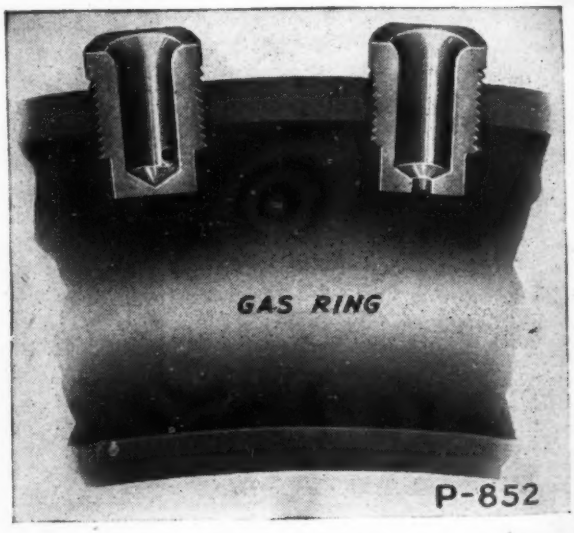
provide many operating advantages

The National Airoil patented* design Gas Tip is a decided improvement over the conventional type gas tip for cylindrical, ring gas burners, as well as pipe gas burners.

This gas tip, as can be seen in the illustration, has the orifice immersed in the gas chamber so that the orifice is protected from overheating, oxidizing and coking by the cooler gas in the ring. Also, the gas orifice being located in the cup, is screened from most of the radiant heat of the furnace. Because of these features, the gas tips are practically free from clogging or deterioration, even after a long period of continuous operation.



*U. S. Patent No. 2,160,615



National Airoil Gas Tips are furnished in ¼" and ⅜" pipe size, and are made as standard in carbon steel and special in ceramic materials.

NATIONAL AIROIL FUEL OIL - GAS BURNERS

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1250 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PENNA.
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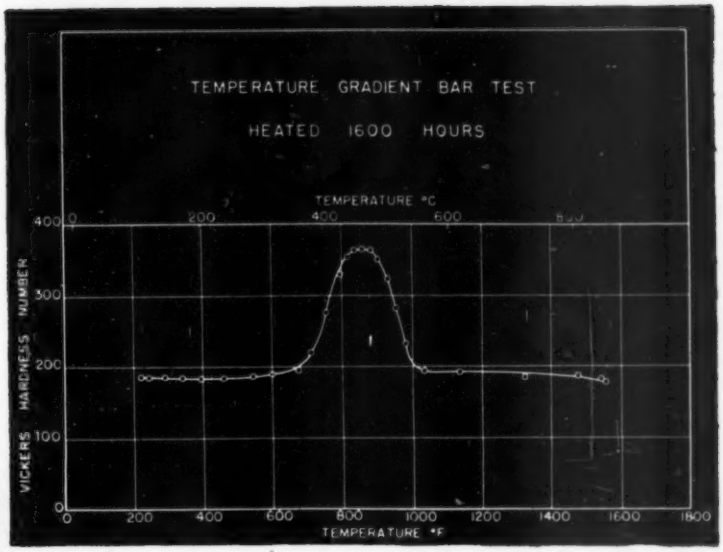
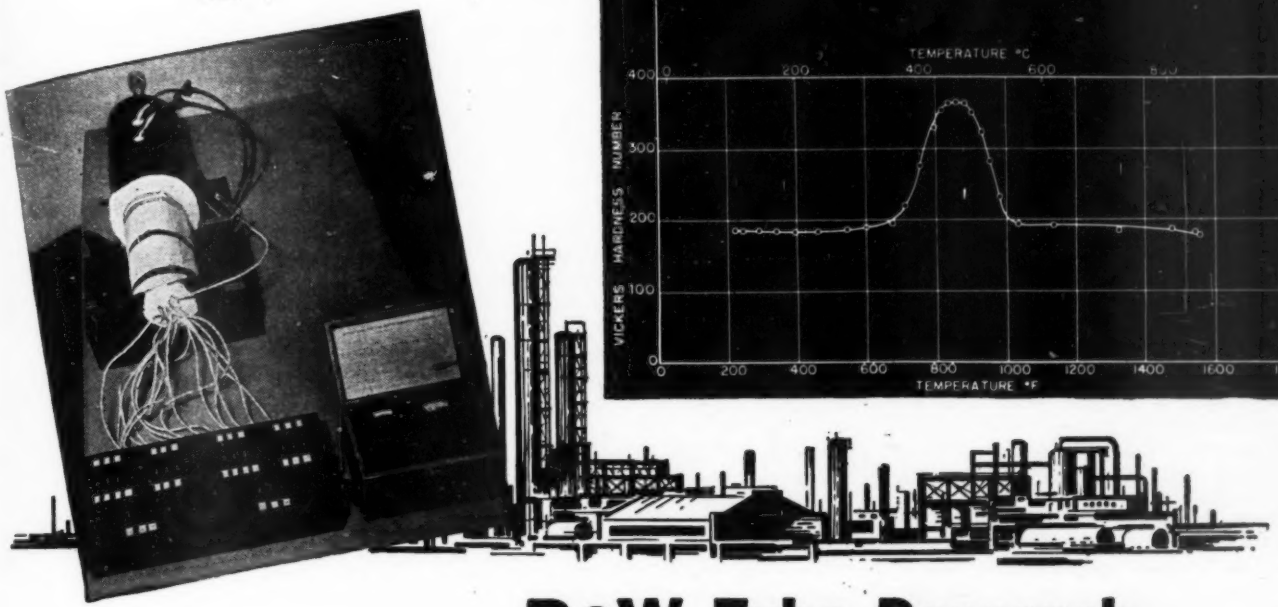
ACCESS DOORS • AIR DOORS • BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

Long-Time Tests Predetermine Long-Time Service

(Right) **Fig. 1. Hardness — Temperature Curve Obtained by B&W Gradient Bar Test.**

(Below) **Fig. 2. Special Set-Up Developed by B&W for Gradient Heating of Test Bars.**





B&W Tube Research Tests High Alloy Steels' Behavior Through Their SERVICE RANGE

The Babcock & Wilcox Tube Company is continuously studying the behavior of highly alloyed steels under temperature environment so as to forecast utility and performance in high temperature applications. As a consequence, B&W may be expected to furnish accurate information on properties of ferrous metals for application in the newer oil refining processes and for other chemical process work, including production of raw materials for synthetic rubber.

In B&W's large, complete laboratories furnace equipment is utilized for long-time heating tests wherein changes in physical properties or alteration in structure and other effects of heating may be determined. Figure 2 shows a special set-up developed by B&W for gradient heating where a complete service range of temperatures may be covered. The test bar, after heating, is subjected to a careful survey at thermocouple locations for changes in hardness and structure. Aging or embrittlement temperature ranges may thus be precisely located and thereafter specific studies made to determine the effect of embrittlement on physical properties. Figure 1 shows a temperature-hardness curve obtained by the gradient bar test.

B&W seamless tubing is available in a complete range of alloy and stainless steels, thus meeting any refinery need. More and more tube users benefit by B&W's research and ability to match tubes to jobs without prejudice toward any particular type. Why not bring your tube problems to B&W?

B&W TUBES

ELECTRIC-RESISTANCE WELDED
Carbon steel grades
Sizes: ¾ in. to 4 in. O.D.

SEAMLESS
Complete range of carbon, alloy and stainless steels
Sizes: ½ in. to 8⅝ in. O.D.

THE BABCOCK & WILCOX TUBE COMPANY

WELDED TUBE DIVISION
ALLIANCE, OHIO

SEAMLESS TUBE DIVISION
BEAVER FALLS, PA.

B&W MAKES BOTH

TA-1507

cleary that if reaction temperature were controlled, and with a reasonable part of the acid cost charged off to previous use, sulphur reduction to about 0.065 per cent was entirely warranted in better lead response. Since that time we understand that other investigators have carried the reduction to below 0.03 per cent and have found that the lead response was still further improved.

Several processes have been developed for sulphur reduction that do not employ sulphuric acid. Some of these make use of a clay type reagent, either in natural or processed form, and have proved very satisfactory for straight-run stocks but the overall results with pressure distillate have not been such as would indicate the application of the idea to cracked stocks. One thing, however, has stood out in all the work done with the clay-type method. When the clay charge is fresh there is not only a very substantial sulphur reduction, but an actual improvement of several numbers in octane rating of the treated gasoline is observed over the stock charged to the treater. This continues at a sharply reduced rate in the case of cracked stocks, which frequently run 0.75 per cent or more, in sulphur, until in a very short time the action stops entirely.

What was actually occurring, whether or not we knew it, was the isomerizing of certain of the normal paraffinic hydrocarbons, thus improving the octane number of the treated stock. The surface of the clay nodules soon became coated with gum and coke, containing the sulphur compounds and other impurities, with the natural result that the isomerizing action ceased. Although many important improvements have been made in catalysts, the chief factor that has made catalytic cracking so successful is in development of methods for revivifying the catalyst, *en situ*, at frequent and regular intervals. In isomerization, the amount of impurities is very much lower and the revivification is, consequently, less of a problem. It is done by maintaining a slight but carefully controlled concentration of hydrogen chloride in the aluminum chloride with which the solid part of the catalyst is coated.

▼ **Mechanics of butane isomerization.** The first isomerization plants to be erected operated with the butane charge in vapor phase in the catalyst chamber and the catalyst was then, as it still is, aluminum chloride. Although the precise mechanism of the reaction is not definitely known, it was found necessary to run a small quantity of hydrogen chloride through the catalyst chamber with the butane stream to act as a promoter of the catalytic action. In these vapor-phase plants the aluminum chloride was almost invariably distributed on a supporting material of irregular shape in order to provide the maximum surface upon which the reaction might take place. With operating temperatures of approximately 250° F. and pressures approximately 200 lb. per sq. in., butane products containing 40 to 45 per cent isobutane have been obtained, though this is not regular practice. This is, of course, based upon once-through operation. The practicable recovery of isobutane per pass is much the same sort of question as in fractional distillation or heat exchange. Contact of the normal butane with the catalyst in the reaction zone effects a rapid change to isobutane but the rate of change falls off as the action proceeds and equilibrium between the relative quantities of the two approaches, just as rate of exchange of heat falls off as the differential of temperature between the heating (or cooling) medium and the stock being heated or cooled narrows. In general, the total recovery is 98 per cent or better.

There were several serious defects in the vapor-phase type of plant due mostly to the accumulation of high boiling point by-products on the catalyst, the activity of which, therefore, declined until it reached a point where it was no longer economic to continue using it. The catalyst was then emptied from the vessel and discarded. This not only presented a disposal problem for the aluminum chloride, but also necessitated discarding the support, which also was coated with non-recoverable catalyst. Moreover, the emptying of a catalyst vessel, several hundreds of cubic feet in capacity, and the bringing into operation of the same vessel filled with fresh, and therefore highly active catalyst, certainly defeats continuity of operation so necessary for smooth and efficient functioning of a modern refinery. In addition, there is the labor involved in emptying and refilling the vessel and the greater attention required of the plant operating men.

▼ **Isomerization in liquid phase.** The solution to the problem associated with vapor phase operations seems to have been found in a liquid catalyst with which butane in liquid phase is brought into contact. Aluminum chloride remains as the essential constituent of such a catalyst, and hydrogen chloride is still found necessary to act as a promoter, but the addition of certain substances to aluminum chloride yields a liquid that can be handled in standard steel equipment. These substances are probably for the purpose of insuring complete absence of moisture and for neutralizing any traces of hydrochloric acid that might be formed in course of operations. moreover, a liquid catalyst lends itself to regeneration, as it is possible to arrange for continuous removal of the by-products, which cause loss of activity, and injection, if necessary, of any constituents of the catalyst that are consumed in the process.

The operating temperature of the liquid-phase process is approximately the same as that for the vapor phase, therefore, the operating pressure must be enough higher to maintain the liquid condition. This is, however, offset by the following advantages:

1. Somewhat higher conversion per pass—45 to 55 per cent regularly.
2. Lower catalyst consumption and lower catalyst cost per unit volume of isobutane produced.
3. No discard and disposal problem associated with the catalyst support.
4. Substantially smaller volume of catalyst required for a given quantity of isobutane.
5. Lower maintenance costs and elimination of labor costs associated with emptying and refilling catalyst vessels in vapor-phase operations.

▼ **The flow sheet.** The accompanying flow diagram is to be considered largely as schematic, because the aim is to bring out some of the salient features of both the vapor and liquid phase types of operation. The isomerizing reaction is mildly exothermic and, utilizing this heat, little additional heat from outside sources is necessary. In any case, a direct-fired heater is not warranted. The fractionating tower is not shown in the diagram because an isomerization unit is frequently a part of an alkylation plant and the necessary fractionation for both processes is logically carried on in one tower, because the required conditions are similar. It should also be noted that when the operation is carried on in liquid phase the excess pressure will probably be sufficient so that the hydrogen chloride stripper charge pump can be replaced by a vapor relief valve. A refrigerant may be necessary as a reflux condenser on the hydrogen chloride stripping column to insure against carry-over of butane vapors.

In conclusion the writer expresses his appreciation of the cooperation of Foster Wheeler Corporation in extending permission to use the flow diagram and to avail himself liberally of quotations from their publications, particularly from the article "Liquid Phase Isomerization," which appeared in the May-June, 1943, number of *Heat Engineering*. ★★★

POSTWAR PLANNING

"Postwar planning in the petroleum industry will have to give due consideration to the fact that billions of dollars' worth of oil products and oil transportation facilities will be on the market for disposal by the federal government.

"Recent figures have come to light as estimates on some of these holdings from sources which must be presumed to carry the weight of some responsibility—the special Senate small business subcommittee, headed by Senator Stewart (Dem., Tennessee), for example.

"Two items alone of direct interest to the petroleum industry have been detailed in a report by this committee estimating value of property to be declared surplus in the hands of the government at the end of the war.

"One of these is petroleum products, the value of which is rated by the report at $2,100,000,000 (yes, those are billions of dollars).

"The other is oil tankers, calculated to be worth $1,970,000,000."

Keith Fanshier, oil editor,
The Chicago Journal of Commerce

One for All and All for One...

preventing Vapor Losses

Gasoline vapor losses take a tremendous toll in dollars and cents . . . and, most important today, in the loss of a vital war supply. Yet this loss can be easily prevented.

The Graver Expansion Roof Tank retains all vapors instead of expelling them. As vapors expand, due to temperature or volume increase, the roof rises, providing extra vapor space as needed. Decrease in volume or temperature causes the roof to descend again, and, since it is oil sealed all around, no vapors can escape and there is no breathing in of moisture-laden air.

But that's only part of the story. When several cone roof tanks are spaced reasonably close together, they can be manifolded to the vapor space of a Graver Expansion Roof Tank of suitable size, providing protection for the entire group . . . one for all.

Whether it's a matter of more gas for Victory or more dollars in the bank, the answer lies in Graver Expansion Roof Tanks. They will, within a reasonable length of time, pay for themselves just as they are doing at refineries and pipe line terminals of many leading oil companies.

Start this saving now. Write for full details without obligation.

GRAVER EXPANSION ROOF TANKS

- Prevent vapor loss
- Maintain octane rating
- Require no more maintenance than ordinary cone roof tanks
- Provide self roof drainage
- Can be adjusted from outside, with all mechanism enclosed

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FROM DIMITY TO DENIM

MILADY of yesteryear scarcely would recognize the fashion parade of today. A new wartime vogue has swept the nation and stolen the show. Work slacks, anklet sox, tight headwraps, safety shoes, and heavy gloves have come into style as fashionable American women trade dimity for denim and go to work in this country's war plants.

Such a mode wasn't dreamed of in milady's era of silk and satin. But World War II caused many changes — and America met each in stride. The switch in industry where denim-clad women take over jobs formerly done exclusively by males is one of the greatest social adjustments of the war.

At first, some businessmen were dubious. They weren't sure woman could master the muscular tasks of big industry. True, they conceded, women had done well in offices, stores, and professional fields such as medicine and law, but for the so-called weaker sex actually to shoulder the nation's production wheels—well, maybe.

The current manpower shortage has given woman a chance to prove her skill, and she is doing it in nearly every line of business activity—even in the rugged oil industry, long considered a place for he-men only. Take Continental Oil Company for example.

Little more than a year ago, any visitor permitted to enter the closely guarded gates of Continental Oil Company's Ponca City, Oklahoma, refinery, would have seen an industry run almost entirely by men. The only women then employed in the big, modern Continental plant were a few office workers and 28 company-trained women testers who had replaced men in the important control laboratory.

Today, the same visitor would be astounded if he were to stand at the refinery entrance and watch Continental's industrial Amazon army of 300 going on and off work shifts. Those 300 are a part of the company's 1031 women at war—women who by their daily work in the refinery, offices, and field departments are proving their ability to tackle tough jobs like real all-Americans.

WHO are these wartime Eve Curies? From where did they come? And why? They are mothers, wives, sisters, and sweethearts. Nearly all have men serving in the armed forces. Before Pearl Harbor these women war workers were engaged in varied activities. Many were housewives. Others were office workers, clerks in stores, school teachers, waitresses, high school and college students. Mrs. Mila Wolfe, stenciler at the compounding and packaging plant, spent 12 years as owner and manager of a restaurant business. Mrs. Lala Morris, lift truck driver at the C and P plant, formerly was a telephone switchboard operator, then a housewife.

When you ask these home-front fighters why they chose to enter a masculine industry, the reply is unanimous. "We want to help win this war." And, they mean it! Sure, war jobs pay good money. But, there has to be more incentive than cash when you tie into a job such as that held by Mrs. Mildred Walker, operator of the crane in Continental's huge machine shop. Working eight hours a day moving tons of heavy materials is a tough assignment. Ask any man who has done it. How's Mrs. Walker doing at the job? "Swell," say her supervisors.

Continental Oil Company puts an industrial army of Amazons to work in its Oklahoma refinery...The majority are duration workers who have men in the armed forces and want to help win the war.

After the war, the woman crane operator plans to resume the household tasks she has left temporarily. But first comes victory!

Most of the women are on the oil production line so that they may help bring fighting men home quicker. Typical is Mrs. Golda Mooney, wife of Sgt. Charles Mooney now stationed in Hawaii. Mrs. Mooney, mother of two young children, is convinced that her job of filling barrels of oil and checking petroleum shipments at Continental's C and P plant will help hasten her husband's homecoming. And, when the sergeant returns, he is going to find that his wife has been postwar planning. With the aid of money earned by filling oil drums, Mrs. Mooney has completely paid for a home that she started to buy about a year ago.

Della and Stella Durland, 19-year-old twins employed as fillers in the C and P plant, are home-front fighting for their two brothers — Ed, in England, and Charles in the Gilbert Islands. On the same job with the twins are two other Durland sisters, Evelyn and Lucille, whose husbands are serving with the army in England. While the four sisters work and share a two-room apartment in Ponca City, their parents grow victory foods on a farm near Broken Bow, Oklahoma, thereby completing an all-out family war effort.

IT WAS March, 1943, when the first contingent of 15 women war workers was employed in Continental's C and P plant. Other than a small group of laboratory testers and a few office workers, those 15 were the first women refinery workers in the history of Continental Oil Company. Quickly they learned unfamiliar tasks like filling and stenciling and checking shipments of petroleum products destined for the war fronts and civilian markets. Later, more women were added to the C and P staff, and others were assigned to similar tasks of barrel-filling and stenciling in the grease plant.

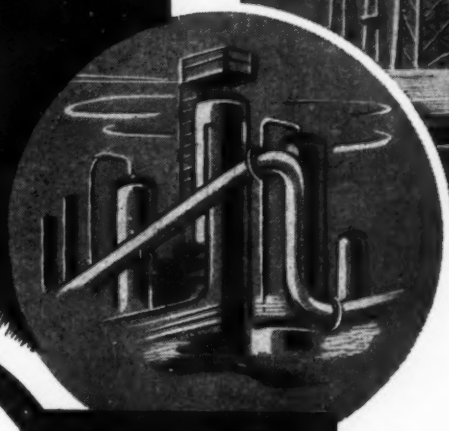
Then came the early days of 1944 and a manpower drain in both the refinery and Continental's new 100-octane gasoline plant necessitated the addition of more women recruits to Continental's industrial army. Subsequently, homemakers replaced men on such jobs as yardwork and maintenance, canning machine operators, barrel cleaners, warehouse helpers, and tool room attendants—to mention only a few of the arduous jobs.

Mrs. Jo Adkinson, a postmistress at Grainola, Oklahoma, during the last war, jumped into the fight again this time as a boiler-fireman helper at the 100-octane plant. She and her husband, a veteran of World War I, have one daughter in high school and another who is a Link trainer instructor formerly employed at the Darr School of Aeronautics at Ponca City, until recently a training base for British and American fliers.

As man after man swapped industrial tools for fighting equipment, new groups of women rushed to answer the country's call for manpower. Mrs. Vivian Lewis left a small farm near Ponca City to become gate checker at Continental's busy refinery entrance. There she keeps an eagle eye on each truck going into the refinery. When off shift, she spends several hours each month nursing the sick at a Ponca City hospital.

Mrs. Helen Earickson, a former waitress, became a "board woman" or control board operator at the 100-octane plant. Her readings of the many instruments, her reports, and calculations are important factors in controlling the operation of the feed preparation and recovery unit of the high octane plant. Mrs. Ola Marie Bartlett, a former office clerk, assumed similar responsibility as "board woman" for the thermofor catalytic unit. Mrs. Lois Hand, mother of four boys all under 10 years of age, became a casing machine operator in the grease plant when her husband joined the army. It is the first job young Mrs. Hand has had, and she is doing it "just until the men come back." "When peace comes," Mrs. Hand emphasizes, "I'm going to take over my old job taking care of the children." At present, her father-in-law is looking after Bobbie 9, Jimmie 6, Tommy 4, and Terry 3.

AT EVERY CRITICAL POINT···
FROM WELL HEAD TO REFINERY··



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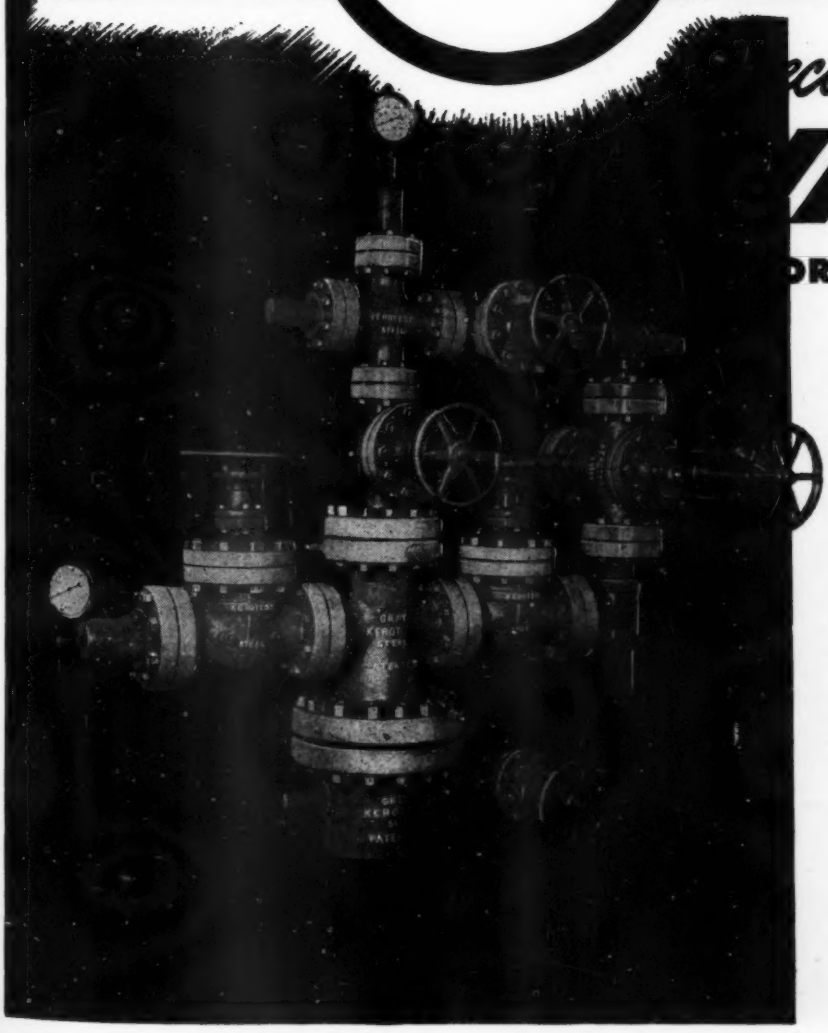

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Soon, the labor shortage eased somewhat as these, and other women, became modern minutemen and switched from home to home front almost overnight.

All around the Continental manufacturing department there is evidence of woman's knack in handling the tools of industry—of doing men's jobs well. Women gaugers nimbly climb refinery storage and rundown tanks to obtain samples of petroleum products. Women loader-helpers stand high on loading racks to help fill tank cars with precious oil. On the loading docks and cleanup squads young girls just out of high school throw the same enthusiasm into war work as they used to put into the Friday night jitterbug session. Women, too, drive pickup trucks that shuttle on delivery trips between the refinery and 100-octane plant.

In the Continental laboratories where 28 women testers worked little more than a year ago, there are now approximately 60, plus four women graduate chemists who do analytical work in the control and gas analysis laboratories. But, not all of Continental's wartime conversions to womanpower have been made in the manufacturing department. An even greater turnover has taken place in office personnel. The mailing and stationery division, once staffed entirely with males and one woman stenographer, now has 11 women and three men! Most offices have experienced a similar change. Everywhere in the Continental organization women are picking up desk tasks left by men—and, business goes on!

The five o'clock bell that closes the office day, and the refinery whistle that calls for shift changes at 7 a.m., 11 p.m., and 3 p. m., do not signify that the women's day is done. After work hours there are houses to be cleaned, clothes to be washed and mended, lunches to be packed, shopping to be done, and children to care for. Some of the women hire assistance for their home chores, but help is scarce and the work must be done!

Both the young and old, married and unmarried women spend many hours of their leisure time as nurses aides, Red Cross assistants, and U.S.O. hostesses. For other recreation many of them go to Continental Oil Company's modern gymnasium where badminton, roller skating, table tennis, and other forms of athletic activity keep them physically fit for the vital jobs they must fill on the oil production front. War is serious business and these women war workers are out to win. Silks and satins can wait!

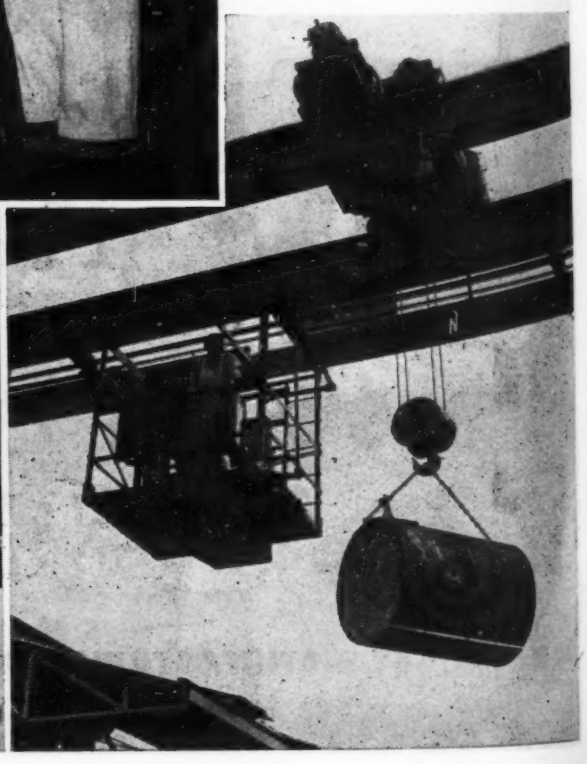
★ ★ ★

▼ **Mrs. Adah Lindsay, gauger, pauses on her long trek up a 10,000-bbl. storage tank. Her husband and stepson are fighting in Italy.**

▼ **Viola Nutt, engineer's helper in the 100 octane gasoline plant's compressor building, oils a rocker-arm mechanism on a gas-driven compressor. She was a taxi driver.**

▼ **Lala Morris, life truck or "jeep" driver, swings onto the loading dock with two drums of Conoco Nth Oil ready for shipment.**

▼ **Mrs. Mildred Walker, crane operator in Continental's big machine shop, daily moves tons of heavy materials for shop workmen. Formerly she was a housewife.**



TIME SAVING

Computing Instruments For Spectroscopic Analysis

By T. D. MORGAN and F. W. CRAWFORD
Phillips Petroleum Company

CHEMICAL plants throughout the country, having reached an all-time high in the production of critical war materials, depend on rapid analytical methods as a guide in keeping "on stream." Successful applications of spectroscopic methods to these analytical problems have shortened the time interval from sampling to completion of an analysis at a big saving in technical manpower. The principal time consumed now in a multicomponent analysis by spectrophotometry is due to the rather lengthy computations. Several short cut mathematical methods have been developed in attempts to reduce further the overall time for completion of an analysis but this article presents a method of demonstrated usefulness as well as a description of electrical computing instruments for carrying out the steps of the method.

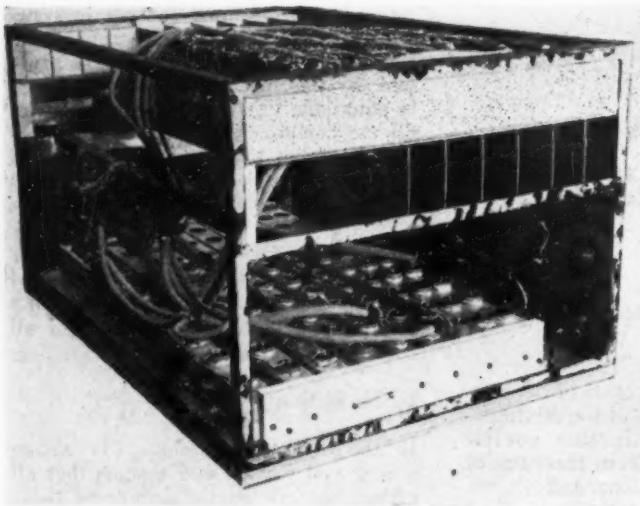
One instrument herein described in principle will solve quickly any set of simultaneous equations of the type ordinarily found either in absorption spectrophotometry or mass spectrometry. In particular, an instrument for solving seven equations in seven unknowns has been developed and its practicability demonstrated in field tests at the Plains Butadiene Plant Laboratory, Borger, Texas. Also, a second instrument has been developed for reducing spectrophotometer data to extinctions.

When an infrared spectrophotometer is used for making analyses of multicomponent mixtures the data consist of galvanometer deflection readings. These deflections are caused by approximately monochromatic infrared light reaching a sensitive thermocouple. Two deflections are read at each pre-selected wave length; one (I_0) with an evacuated cell in the light path and the other (I) with the same cell containing the unknown mixture in the path. The extinction (K) of the absorbing gas is defined as log $\frac{I_0}{I}$. The computation necessary to get these extinctions may be done by logarithms, slide rule or by the electrical computing machine explained below in which every mathematical operation in the above computations has an electrical or mechanical counterpart.

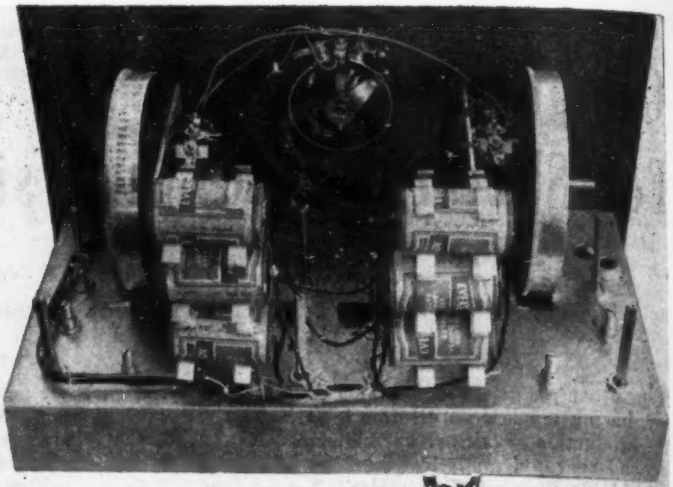
By way of illustration, here is a set of simultaneous equations such as are found in the process of analysis by infrared spectrophotometry. These equations are set up from instrument calibration and sample data where:

x, y, z . . . are per cents of the components of the mixture,
A, B, C . . . are extinction coefficients from instrument calibrations, and
K . . . . . are extinctions measured at appropriate wave lengths for a particular sample.

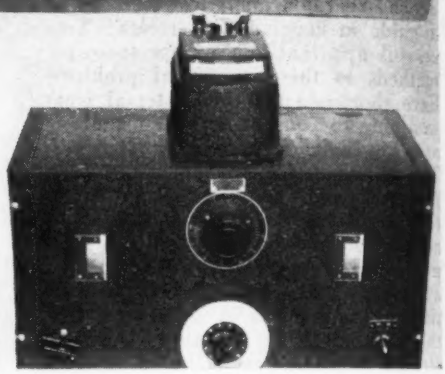
$$\begin{aligned} A_1x+B_1y+C_1z \quad . \quad . \quad . &= K_1 \\ A_2x+B_2y+C_2z \quad . \quad . \quad . &= K_2 \\ A_3x+B_3y+C_3z \quad . \quad . \quad . &= K_3 \\ \cdots\cdots\cdots\



Side view of 7-component computer with case removed showing battery, slide wire, potentiometers, wiring.

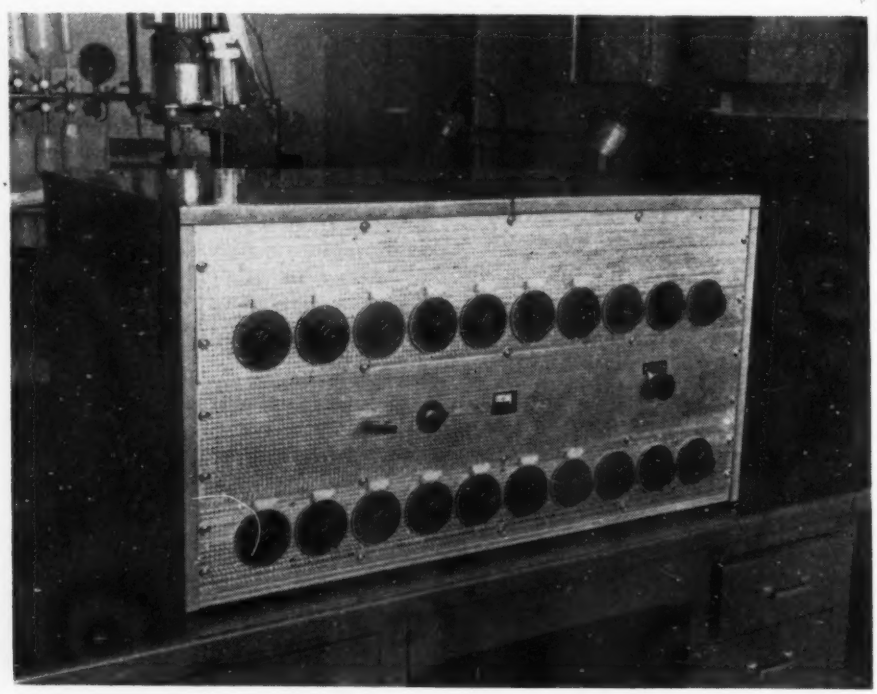


Rear view of extinction computer logarithmic dials for I_0 and I.



Electrical instrument to reduce spectrophotometer readings to extinctions.

Electrical computer for solving 7 simultaneous equations with 7 unknowns. Additional dials and space inside the case have been provided for expansion to 10 components.



The mathematical representation of what happens when successive approximations are made is illustrated by a consideration of the following set of two simultaneous equations with two unknowns. A two equation system was chosen for this presentation for simplicity although the expansion may be carried out for a system containing more than two unknowns with similar conclusions.

Beginning with x and carrying out a number of successive approximations to y in the system:

$$A_1x + B_1y = K_1$$
$$A_2x + B_2y = K_2$$

the *m*th approximation of $y = \frac{K_2}{B_2} -$

$$\frac{A_2K_1}{B_2A_1} + \frac{A_2B_1K_2}{A_1B_2^2} - \frac{A_2^2B_1K_1}{A_1^2B_2^2} + \frac{A_2^2B_1^2K_2}{A_1^2B_2^3} - \frac{A_2^3B_1^2K_1}{A_1^3B_2^3} + \frac{A_2^3B_1^3K_2}{A_1^3B_2^4} - \frac{A_2^4B_1^3K_1}{A_1^4B_2^4} \cdots\cdots \frac{A_2^{m-1}B_1^{m-1}K_2}{A_1^{m-1}B_2^m} - \frac{A_2^mB_1^{m-1}}{A_1^mB_2^m}K_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

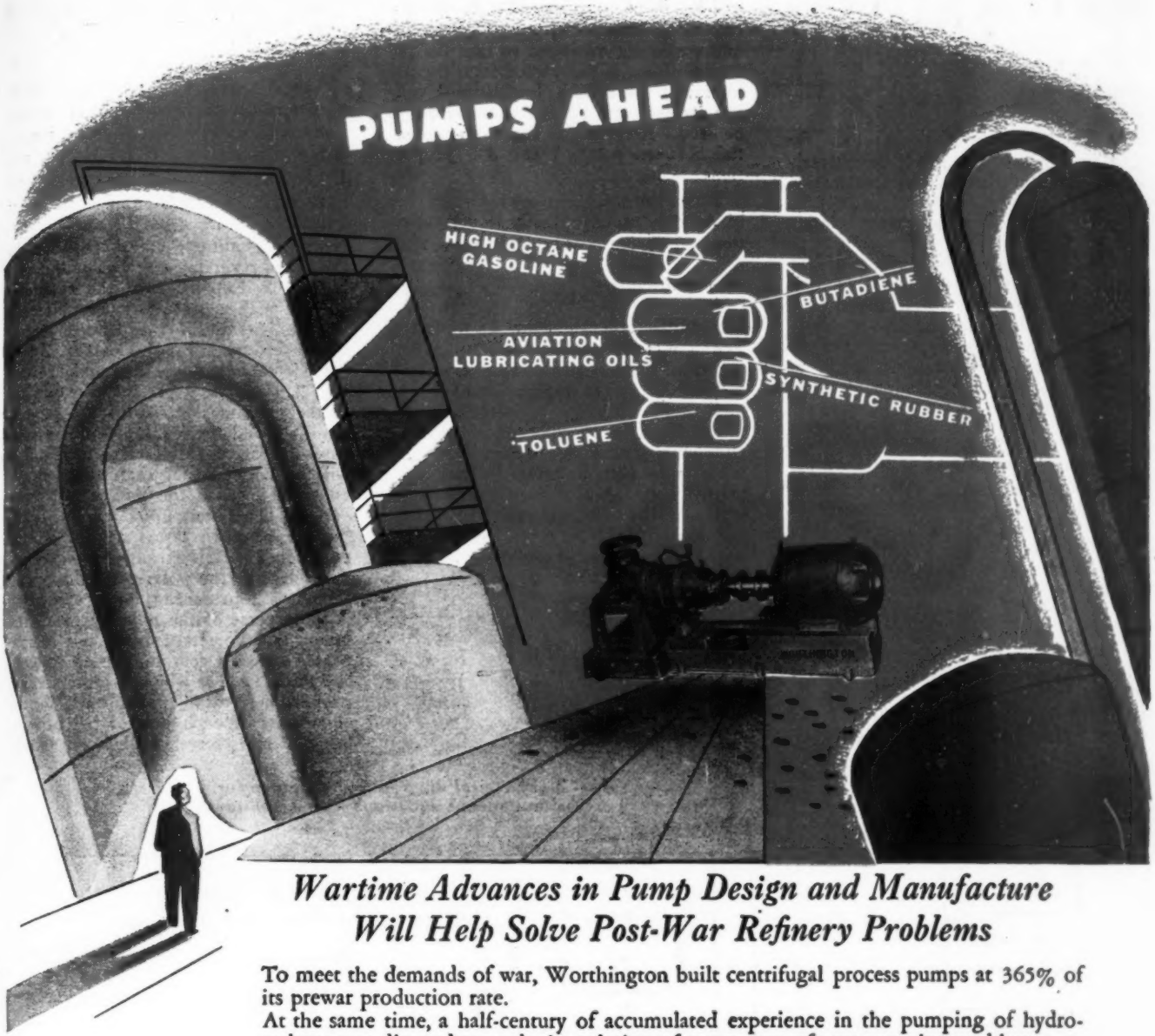
As a test for convergence in the foregoing series let us consider the ratio of the last term of the series to the next to the last term: $\frac{A_2K_1}{A_1K_2}$

Or substituting equivalent values for K_1 and K_2: $\frac{A_2A_1x + A_2B_1y}{A_2A_1x + A_1B_2y}$

If this ratio is less than one or if $A_2B_1 < A_1B_2$, the series converges. In the general set of equations (1) if $A_1 > B_1A_1 > C_1 \ldots$ and $B_2 > A_2$, $B_2 > C_2 \ldots$ and $C_3 > A_3$, $C_3 > B_3$, the series of successive approximations converge rapidly so that the method yields a sufficiently accurate solution to the simultaneous equations in a few computation cycles. In infrared spectroscopy this means that if wave lengths can be chosen at which only one component causes chief absorption, then the above method of calculation may be used to advantage.

It is found in practice that the order in which the equations (1) are placed influences to a large extent the number of successive approximations required to obtain correct answers. Although an attempt is made to select a wave length for each component at which only that component causes chief absorption, it is not always possible to do this. Consideration of equations (2) in the following form will illustrate how the order of calculation changes the number of successive approximations required to obtain a satisfactory solution.

$$x + \frac{B_1}{A_1}y = \frac{K_1}{A_1}$$



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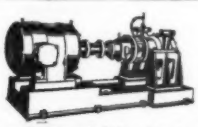
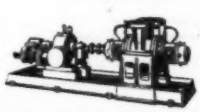
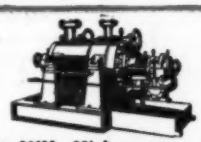


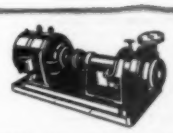
Types HR and HB. Twenty sizes. Capacities up to 1800 g.p.m. Developed heads up to 900 ft. Proper selection of materials permits use for temperatures far below zero to 800°F., for pressures from high vacuum to 750 lb. per sq. in. gage.



Type HD. Hydraulically-balanced, double-suction impeller handles boiling liquids with low submergence. Capacities range from 600 to 3200 g.p.m. at heads up to 700 ft., temperatures up to 850°F., pressures up to 550 lb.



Type WH. High-pressure, high-temperature, centrifugal hot-charge pumps. Twelve distinct points of superiority, based on years of experience building pumps for high pressures and temperatures. Capacities to 2000 g.p.m., heads to 5000 ft.



Type HL. Several construction arrangements permit flexibility in application. Designed for temperatures up to 225°F., or higher with water-jacketed stuffing box. Capacities up to 1600 g.p.m., heads to 500 ft.

$$\frac{A_2}{B_2}x + y = \frac{K_2}{B_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

In this set of equations if $\frac{B_1}{A_1}y$ is very small compared with K_1/A_1 then the first approximation of x is very nearly correct as also is the first approximation of y. If $\frac{B_1 y}{A_1 x} < \frac{A_2 x}{B_2 y}$, a correct solution to the equations may be found with fewer successive approximations when x′ is found first than when y′ is found first. As the variables appear in the above condition, it is necessary to have a rough knowledge of sample composition in order to make the best selection of calculating order.

▼ **Electrical computing machines.** All mathematical operations of this computation method may be carried out by the proper addition and subtraction of electrical potentials. We use two machines for this; one to convert spectrophotometer readings to extinctions, necessary only in absorption spectroscopy, and the other to solve the resulting simultaneous equations. The first of these, the wiring diagram of which is shown in Fig. 1, is used to take the logarithm of the ratio I_0/I and divide this by a constant. This converts I_0 and I readings from the spectrophotometer into K_1/A_1 and K_2/B_2 of equations (3). To do this, two linear voltage dividers with logarithmic scales are arranged so that the potential of one is subtracted from the potential of the other. (Logarithmic voltage dividers with linear scales could also be used.) Referring to Fig. 1, the potential between points 1 and 3 is proportional to log I_0/I.

To set the computer for a given value of A_1 it is necessary only to set potentiometers I_0 and I at typical values, then set potentiometer $\frac{K_1}{A_1} = \frac{\log I_0 - \log I}{A_1}$ and adjust potentiometer A_1 until the galvanometer reads zero. The functional details of this circuit can be followed by a straight forward application of Kirchhoff's laws.

Fig. 2 is a wiring diagram of the electrical computing instrument for solving simultaneous equations. A four component system was chosen for purpose of illustration although the instrument was actually built for seven components. In the following set of equations all variables and coefficients are real.

$$w + \frac{B_1 x}{A_1} + \frac{C_1 y}{A_1} + \frac{D_1 z}{A_1} = \frac{K_1}{A_1}$$

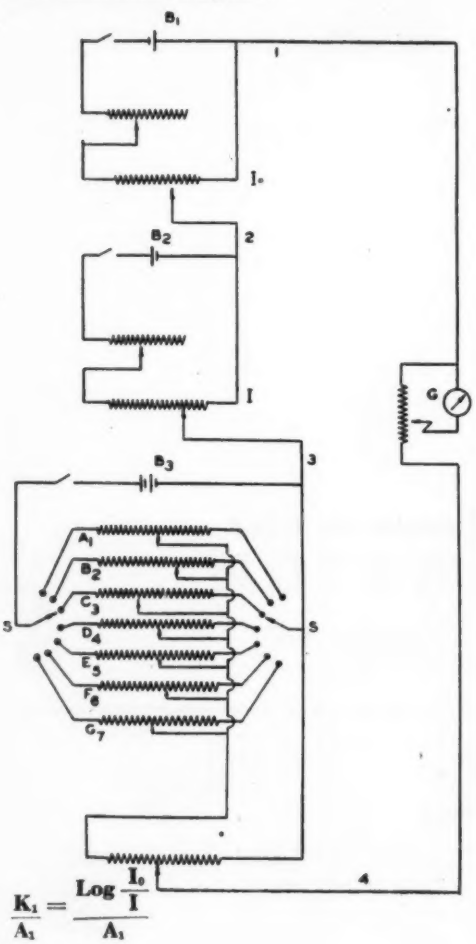
$$\frac{A_2 w}{B_2} + x + \frac{C_2}{B_2}y + \frac{D_2}{B_2}z = \frac{K_2}{B_2}$$

$$\frac{A_3}{C_3}w + \frac{B_3}{C_3}x + y + \frac{D_3}{C_3}z = \frac{K_3}{C_3}$$

$$\frac{A_4}{D_4}w + \frac{B_4}{D_4}x + \frac{C_4}{D_4}y + z = \frac{K_4}{D_4} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

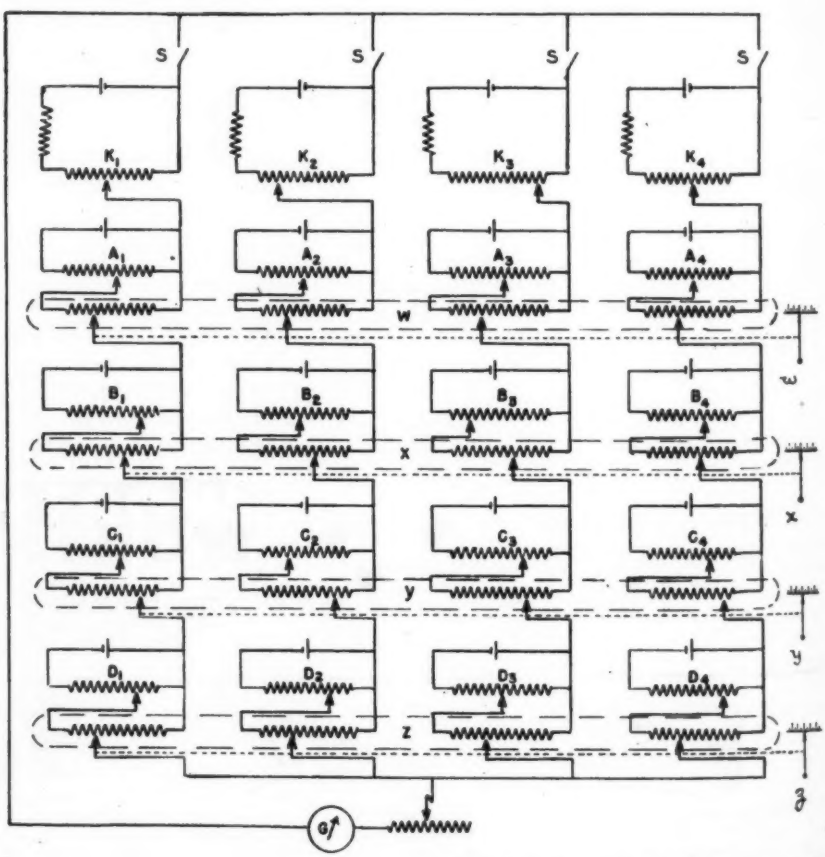
The A's, B's, C's, and D's of these equations are proportional to the extinction coefficients of w, x, y, and z, respectively at wave lengths L_1, L_2, L_3, and L_4. K_1, K_2, K_3, and K_4 represent total extinctions of the sample at wave lengths L_1, L_2, L_3, and L_4, respectively. Negative quantities may be handled by the use of reversing switches on the cells of Fig. 2. Expansion of the computer for use with a greater number of components is straightforward. For example, to convert the computer of Fig. 2 to 1 for 5 components each vertical row of Fig. 2 would be expanded to contain 5 battery circuits (in addition to the K circuits) and there would be 5 vertical rows instead of 4. Referring to Fig. 2, it will be noticed that each vertical row contains 5 cells; the polarity of these cells is dependent upon whether positive or negative terms appear in the equation. Fig. 2 is arranged for all positive terms so the polarity of the potentiometers representing total extinction is the reverse of the polarity of all the other potentiometers. Each cell is connected across a combination of 2 potentiometers, each of which is set to a value proportional to its counterpart in the equations. Of each pair of potentiometers the one closest to the cell should

Fig. 1. Electrical diagram of extinction computer.



$$\frac{K_1}{A_1} = \frac{\text{Log}\,\frac{I_0}{I}}{A_1}$$

Fig. 2. Electrical diagram of computer for 4 linear simultaneous equations with 4 unknowns.



Potentiometers mechanically ganged:
$K_1, K_2 \ldots A_1, A_2 \ldots B_1 \ldots w, x, y, z$ = Equation factors

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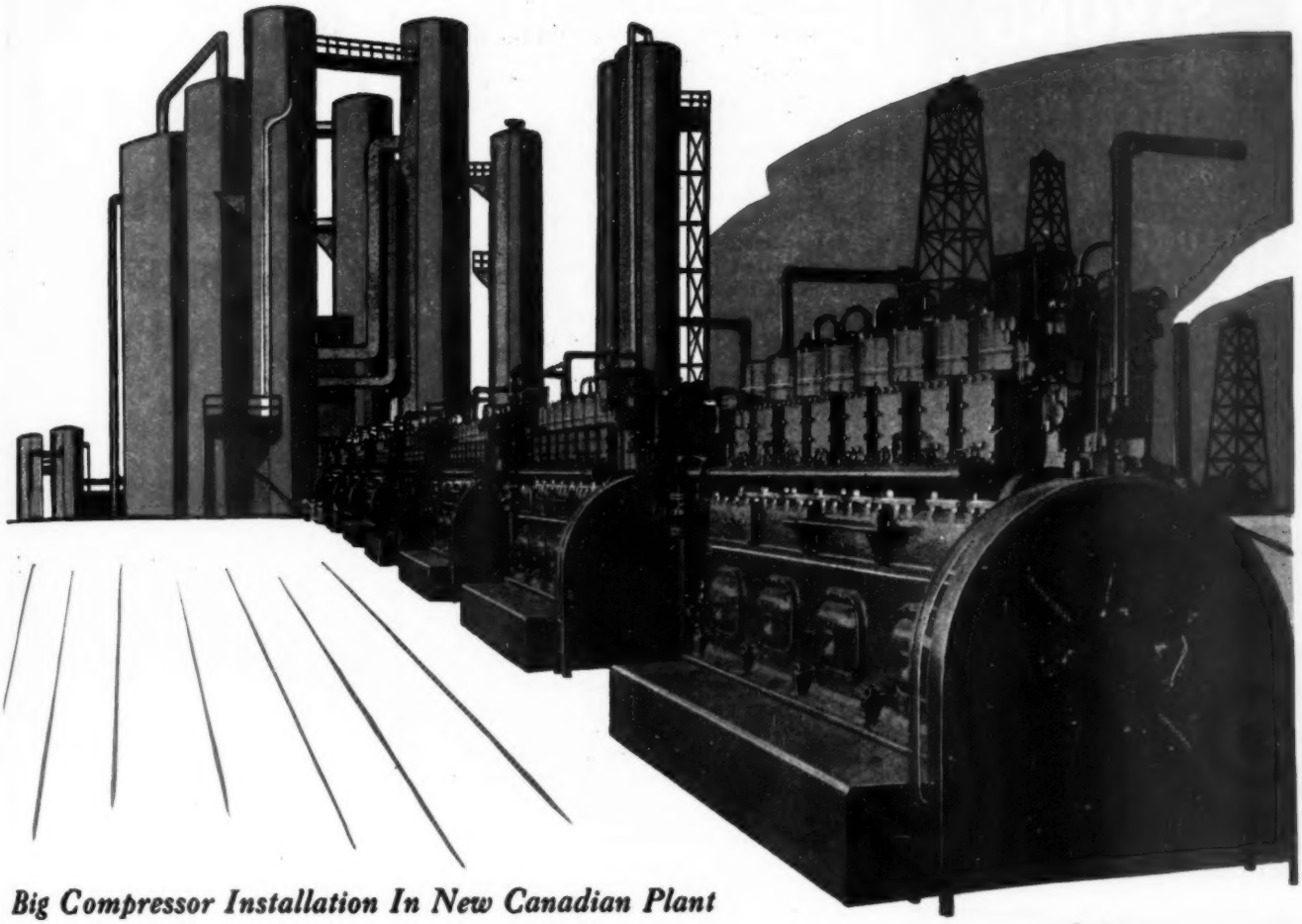

Big Compressor Installation In New Canadian Plant Typifies Worthington's Part In Synthetic Rubber Program

Nine Worthington LFC-type angle gas engine gas compressors are now at work in Canada's new government-owned synthetic rubber plant operated by Polymer Corporation, Ltd. Similar machines have been installed in two identical U. S. plants, making synthetic rubber by the same process.

Selection of Worthington for gas compression jobs like this is based on more than proven engine performance. Worthington's broad experience with many aspects of oil and synthetic rubber production — in oil fields, in refineries, in butadiene plants — places larger engineering resources at Industry's command.

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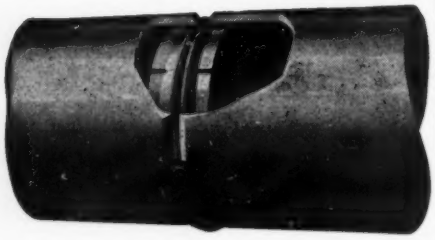

done easier and better. You can use help with less skill and experience and get very good results and your experienced help can do much more. For the future, you get STRONGER joints and for that reason eliminate the possibility of serious and costly breaks. When there is shock, strain or vibration the REINFORCED joints will not break.

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be low in resistance compared to the other one for the system to perform exactly according to the theory of the computational method but in the present instrument all the potentiometers are alike and no problems have been encountered that would not converge to a solution on the computer. This makes it possible to order a large number of one kind of potentiometer and select the best ones for critical parts of the circuits.

When the total potential from all cells of 1 circuit is zero, indicated by zero galvanometer deflection, the equation represented by the circuit is balanced. When all circuits are in balance, all equations are balanced and the solution may be read off the dials.

▼ **Details of setting coefficient potentiometers.** Calibration of the computer of Fig. 2 is done by setting the dials on the A, B, C, and D potentiometers according to the spectrometer calibration data. This may be done by assuming in equations (4) that all the variables except w are zero and hence that w equals 100 per cent. The right hand member of each equation is then known and these values are set up on the respective dials of the K potentiometers in Fig. 2. Each circuit is then balanced by adjusting the dials on the A potentiometers. It is next assumed that x is 100 per cent and the B potentiometers set, then y and z are each assumed to be 100 per cent while the C and D potentiometers are set.

▼ **Operation of computer.** To use the computer on infrared spectroscopic data, I_0 and I are first reduced to extinctions and divided by the extinction coefficients of principal absorbers on the computer as outlined above. These values are then equivalent to the right hand members of equations (4) and are set on the respective dials of the K potentiometers of Fig. 2. In Fig. 2, switch S_1 is closed and galvanometer G is zeroed by adjusting the dial of the w potentiometers. Then S_1 is opened and S_2 is closed and the galvanometer is zeroed by adjusting x. Circuits 3 and 4 are balanced in a similar manner by adjusting y and z, respectively. Returning to circuit 1 it will be found that the galvanometer no longer reads zero when S_1 is closed, so w is again adjusted to balance the circuit. These zeroing manipulations are repeated until the galvanometer reads zero without turning a dial as each switch is closed separately. When this condition has been reached the solution to the set of simultaneous equations may be read directly from the dials w, x, y, and z. Each cycle of these manipulations amounts to obtaining an approximation in the computational method above. Seven circuits can be balanced in about one minute and 3 cycles are usually sufficient to arrive at the answer.

The computation method shown here has been in use for nearly a year. Recently the electrical computing machines were given field tests at the plant and have already saved much time in making analyses. ★ ★ ★

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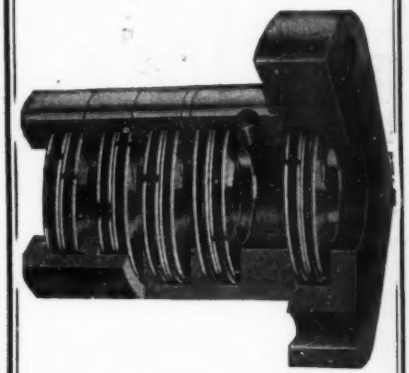

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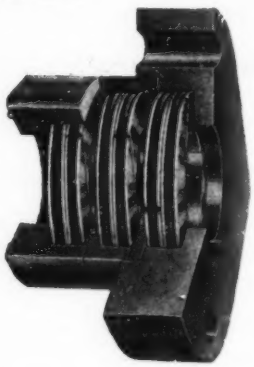

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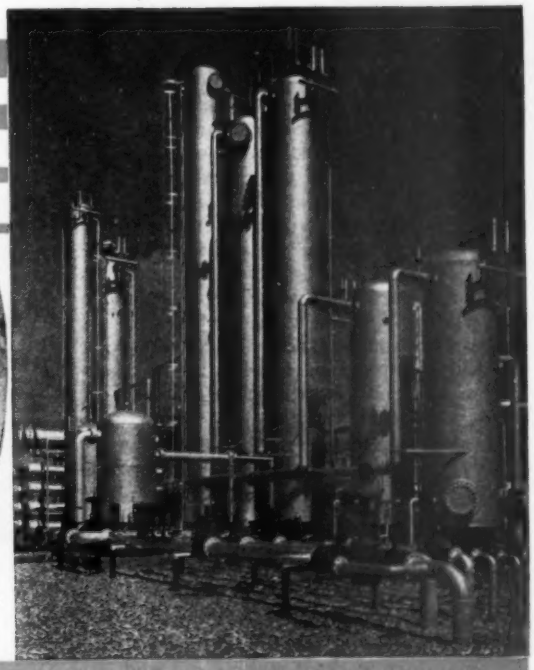

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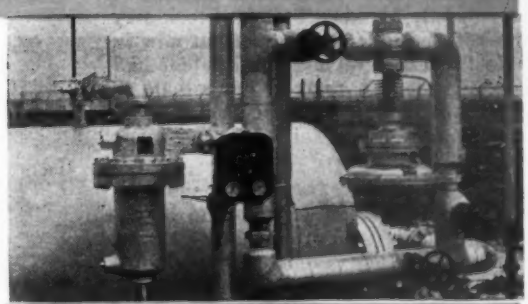

H-W Type 850 Displacement Level Controller Torsion Tube Assembly on Stabilizer Reboiler. Type 850 controls liquids of any gravity, temperature or working pressure.

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EFFICIENT DEVELOPMENT OF ELK HILLS NOW UNDER WAY

By WALLACE A. SAWDON
Pacific Coast and Foreign Editor

Navy Department and Standard Oil of California conduct operations under a unit plan contract that looks promising for highest ultimate production totals.

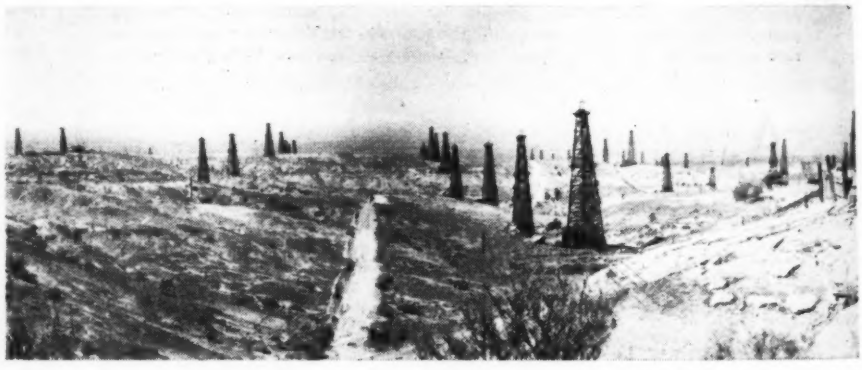
EXCLUSIVE ORDERLY development by means of a unit plan is now in progress on Naval Petroleum Reserve No. 1 at Elk Hills, California. This is assured by the fact that experienced oil men are in charge of operations that will be conducted under a unit plan contract between the navy department and the Standard Oil Company of California. The work is being done under supervision of an an operating committee consisting of one navy representative, Commander Harry P. Stoltz, and one Standard Oil representative, Victor Wankowski. Al Tietze, general production superintendent, Standard Oil Company of California, is in charge of producing operations under the supervision of the navy.

Standard is doing the development work on an actual cost basis. This does not include any general company overhead nor any administrative or executive expense other than that connected with direct Elk Hills operation. All expenditures by the navy are being kept at a minimum. Cooperation between the navy and the oil company is splendid.

Preparatory work of staking out and grading locations and of building roads was done by three Seabee units, the 26th, 7th, and 38th construction battalions. Up to July 21, when Standard took over operations under the agreement now in effect, between 80 and 100 locatons had been graded. A total of more than 30 miles of roads was constructed, including main roads, feeder roads, and roads around locations.

Two zones of an area consisting of approximately 43,000 acres are to be developed under the present arrangement and a sufficient number of wells to increase production from 15,000 to 65,000 bbl. per day will be drilled. More than 200 wells had been completed before the present development work began and possibly 300 will have to be drilled before the desired production is obtained. The new wells are expected to average 200 bbl. per day but the actual production procured will be the governing factor in the number completed.

Approximately one-third of the production will come from Standard Oil Company holdings and two-thirds from navy acreage. The oil company will be permitted to withdraw 15,000 bbl. per day but total withdrawal will not be more than one-third of one-third of the estimated reserve. The navy oil must be applied to the war effort, either directly or through equivalence, and because the characteristics of the crude are such that it yields gasoline of high octane rating it is particularly adaptable to such use. As the object of the navy is to keep the oil of naval reserves in the ground until needed, the secretary of the navy can order reduction or cessation of production when the present emergency is over. In that event the oil company will be allowed to produce sufficient oil from its own properties to meet such charges as taxes, etc., and to keep the field in good condition.



Looking northward along "scar" in which will be laid the main oil line from north side to south side. Pumps will force the oil through a 12-in. pipe line over the hump from two 40,000-bbl. gathering tanks to the Buena Vista tank farm on the south side, where oil will be delivered and sold to purchasers. Gathering of the oil from north side wells through gravitational piping is possible in Elk Hills.

(Official U. S. Navy Photo)

Oil men in charge of operations from the Navy Department and Standard Oil Company of California. Left to right, standing: Lieut. (jg) Reed, Lieut. Domercq, A. W. Noon, chairman of Kern Court Board of Supervisors; Lieut. Eastman, and Lieut. Mettle. Left to right, seated: Victor Wankowski, Standard Oil Company; Commander H. P. Stoltz, and Al Tietze, Standard Oil Company.

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U. S. Navy to survey Alaska for oil

The United States Navy has undertaken the testing of extensive areas in Alaska for oil. Navy geologists and Seabees, in liberty ships, have landed at Point Barrow to begin drilling operations at locations designated by a geological survey party which charted approximately 300,000 square miles of oil-seeped land east of Cape Simpson. It is possible, authorities believe, that the tests may lead to discovery of one of the world's greatest oil fields. The land is located at the northernmost part of Alaska inside the Arctic Circle.

"It has long been suspected by oil men that the Canol and Turner Valley fields in Canada seeped in from a large untapped parent pool," one geologist said. "It is possible that drilling in the Barrow area will locate the parent pool."

Primitive Eskimos have for centuries chopped oil-soaked tundra moss into blocks and burned it as fuel in their underground igloos, geologists said. Reports from the region recently tell of herds of wild caribou trying to ford the oil pools, being caught, and drowned. The Naval party recalled, too, that a freight pilot had narrowly avoided possible crackup and disaster when he discovered the lake on which he was about to land was oil instead of water.

Secondary recovery is contemplated at a later date. When secondary recovery operations are put into effect, dry gas from an upper zone will probably be used with residue dry gas for repressuring. There is also the possibility of water flooding in certain parts where conditions are best suited to water drive.

An estimate of the reserve of the two zones now being drilled on the 43,000 acres of the area in process of development will be presented at the end of six months after starting the present operations. This estimate will be based on established gas-oil ratios and will include an estimate of both oil and gas. The estimate will be made by an engineering committee consisting of three navy men and three oil company men. Collection of data for making the estimate started at the time development work was begun and will include information as it is revealed by well completions up to the time the estimate is made.

There are some small leases within the borders of the area being developed that are held by other companies. These will probably be taken over by the navy within the near future.

Under present plans the wells will be completed either in the Scalez or Mulinia zones with an average depth of 3000 ft. Approximately half the wells will be in the Scalez and sub-Scalez sands and the remainder in the Mulinia and sub-Mulinia sands. Both zones have high porosity and permeability and produce an oil of approximately 20° A.P.I.

The surface spacing of the wells is one well to every 10 acres, but half the wells being completed in one zone and the others in the other zone, the sand spacing will be one well to every 20 acres. There are about 15 strings of tools to be used in the development work, most of these being portable outfits and all operated under subcontract from the Standard Oil Company. At present the drilling time averages 21 days to drill a well, from spud to spud. It is hoped to better this time considerably and expectations are that when all strings are in service one well will be completed per day.

The general drilling program employs a 200-ft. surface string and a 7-in. combination string. In the Scalez sand wells the cementing point is at the Scalez marker; in the Mulinia wells the combination string is cemented in shale above the sand.

Storage tanks are to be supplied by the oil company and the navy will rent these tanks for the storage of its oil. After the war the tanks will be turned back to Standard Oil Company. Production flows by gravity to field storage on the north side of the field and from there it is pumped to the oil company's Buena Vista tank farm for storage until picked up by the pipe line.

All gas is now going to the company's Elk Hills plant but this plant will be unable to handle the additional production from new wells. The gas from these wells will therefore be piped to Standard's natural gasoline plant in the South Coles Levee field where the gasoline content will be extracted and the residue dry gas boosted to a pressure of approximately 340 lb. per sq. in. and put into commercial gas lines being served by the plant. Fuel gas for field operations will be taken from the Elk Hills plant.

A gas zone at from 1500 to 2000 ft. is being cased off in the wells now being drilled. Below the two zones being developed lies the Stevens zone at depths of from 5000 ft. to 9000 ft. This is divided into two productive strata, which are believed to be similar to the same sands at Coles Levee. Four exploratory wells have been drilled to this zone in the Elk Hills field but have been shut in.

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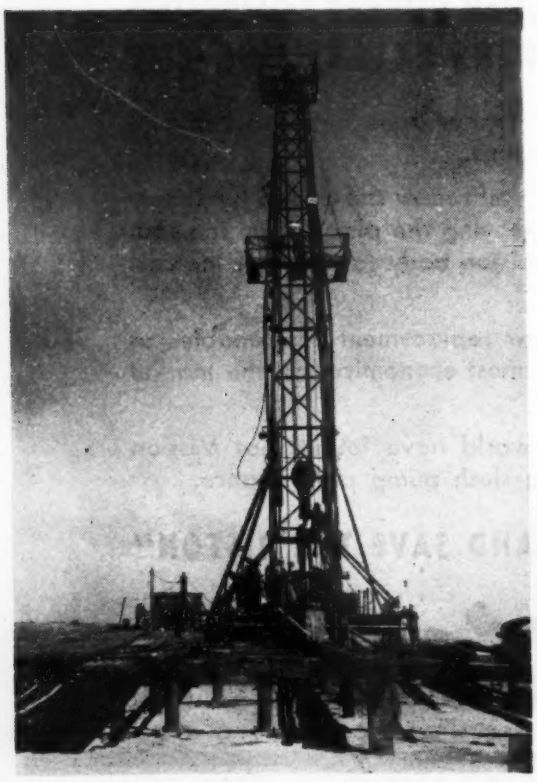
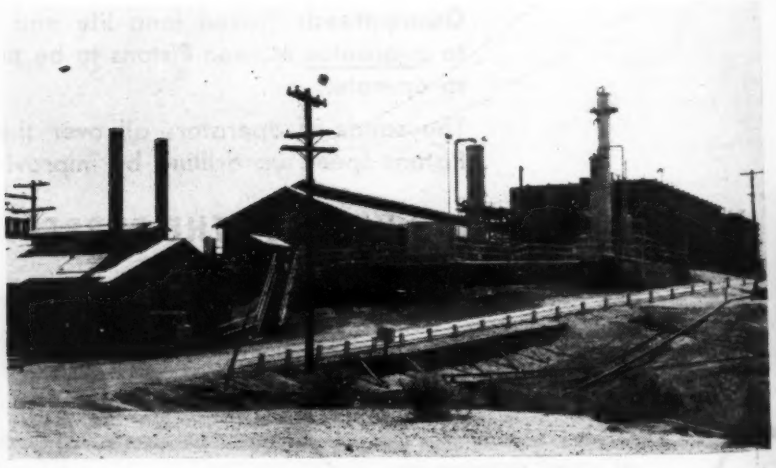


One of the portable drilling rigs in operation. This mast is at Well 61-5G. The day this picture was taken the "string" made 1000 ft. of hole from 500 to 1500 ft. Top of the shallow oil zone, containing 4 sub-zones, is encountered at an average of 3000 ft.

(Official U. S. Navy Photo)

The natural gasoline plant in Elk Hills, taking present gas production from wells. Gas from new wells will be piped to another gasoline plant in the South Coles Levee field.

(Official U. S. Navy Photo)



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P 615.635.4

PROBLEMS IN PULSATING CURRENTS*

By B. BOND, *The Texas Pipe Line Company*

THE purpose of this paper is to call attention to certain problems that have been encountered in dealing with pulsating and alternating currents. These problems may be considered as coming under the three following headings:

(1) Direct current from rectifiers.

(2) Direct current and alternating current combined.

(3) Alternating currents.

From a broad viewpoint all problems in pulsating current may be considered basically as a-c phenomena. Alternating currents are usually regarded as being non-corrosive by most corrosion engineers; however, this type of corrosion has been known as a laboratory phenomenon since 1854 and considerable references to the matter are available in scientific and practical literature.

▼ **Direct current from rectifiers.** Today defective rectifiers are seldom encountered. The following case will give an indication of what may happen when such failures do occur. A tube type rectifier was being used to protect the yard lines and connecting main lines at a pump station in which the pumps and engines were not insulated from the buried structures having cathodic protection. After the cathodic unit had been in operation for several years the heat exchangers in the air cooling system of the engine began to fail. It was noted that the admiralty metal tubes suffered from pit corrosion and failed in 60 to 90 days after renewal. In this case the cooling water flowed around the tubes and all corrosion occurred from the outside of the tubes. Thus, galvanic action between the tubes and the cast-iron case was ruled out inasmuch as galvanic action between iron and admiralty metal should have corroded the iron. Voltage measurements along the exchangers with a d-c. millivoltmeter showed practically no direct current present. An a-c. millivoltmeter was then used and an appreciable a-c. voltage was found. Further checking revealed that turning off the rectifier eliminated the alternating current on the exchangers. The rectifier itself was defective in such a manner that a large a-c. component was present on the protected structures. Conditions at this time were such that the cathodic protection was no longer needed and the rectifier unit was retired permanently. A check of the heat exchanger 18 months later showed no further signs of corrosion.

Since the use of disk and plate type rectifiers has become common, much study has been made of the wave shapes of the protective current. Principle efforts were directed toward development of a "peak" voltmeter, i.e., a voltmeter that would measure the pipe-to-soil potential at the highest point on the voltage wave. A voltmeter of the vacuum tube type was designed and built to indicate these peak values. Field tests were then made in which a full wave plate type rectifier was supplying protection to an underground metallic structure. A voltmeter of the conventional type, reading average values, was used in conjunction with the peak voltmeter and pipe-to-soil potentials were read. It was found that in the immediate vicinity of the rectifier a definite peak existed, the value of this peak decreasing as the distance from the rectifier was increased. Eventually a point was reached at which the pipe-to-soil potential as read by the conventional meter and the peak meter were the same. Apparently condensive action between the pipe and ground, with the pipe coating acting as a dielectric, acted as a filter in smoothing out the d-c. ripples.

Much valuable information has resulted from laboratory work but need is seen for greater field investigations.

In order to study further this type of action, a portable oscillograph was procured. A rectifier cathodic protection system at another location was used for these additional tests. The rectifier was of the single phase, full-wave type. Oscillograph readings of the protected structure to soil potentials were made immediately at the unit and at intervals with increasing distance from the unit. In this particular case perfect half-sine waves of 120 pulsations per second were observed at the unit. As distance from the unit increased, the wave shapes appeared to flatten out and at about 3 miles distant there were no wave shapes visible. For all practical purposes, a pure direct current was being impressed on the structure. Next, the rectifier was connected up for half-wave with the same d-c. output in volts and amperes as was used when operating full wave. Similar tests were made with the oscillograph. The results were of the same order; i.e., definite peaks at the unit with a tendency to flatten out at increasing distances from the rectifier. At about 3 miles distant, as before, the current being impressed on the structure was practically pure d-c. It was noted also that the extent of protection afforded with full wave and half wave, at the same d-c. output, was essentially the same.

▼ **Direct current and alternating current combined.** There are several conditions where a combination of alternating current and direct current may be encountered. Three such conditions are:

(a) Cross country pipe lines containing direct current from earth currents and alternating current from some commercial source.

(b) Structures containing alternating current from commercial source and direct current is imposed for protection.

(c) Structures contain alternating current or direct current and pulsating voltage from rectifier is imposed.

The abovementioned conditions listed as (a), (b), and (c) are commented upon as follows:

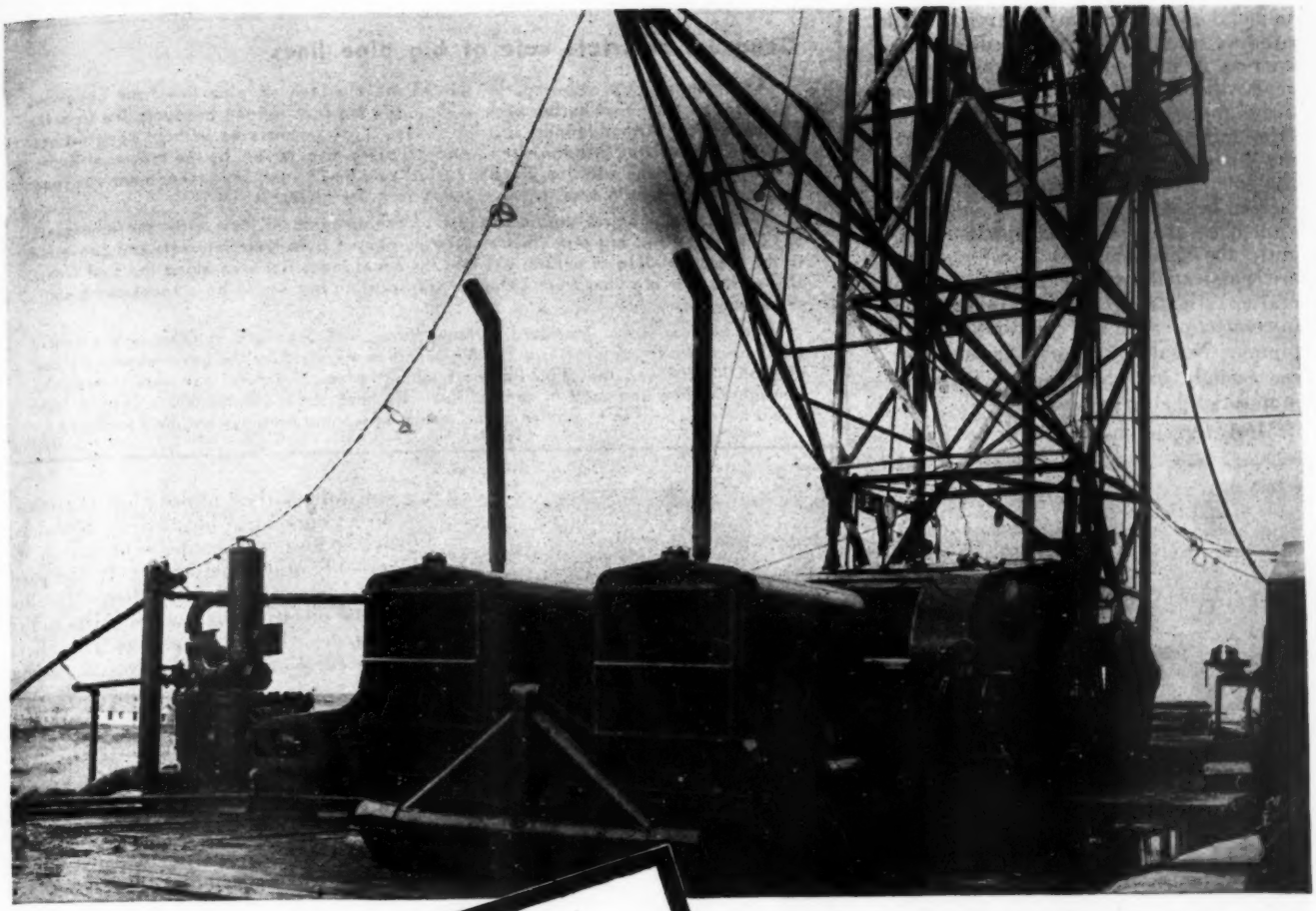
In case (a) resulting potentials may be pulsating direct current or alternating current having a peak voltage in one direction greater than the other. When alternating current is small, a d-c. meter will indicate the average voltage but may not indicate the presence of the alternating current. Thus, ordinary d-c. readings do not indicate the true condition and calculated protective potentials may be wrong. Also, from an economic aspect it may be cheaper to eliminate the alternating current at the source and then proceed to compensate for the direct current.

(b) Cases may exist where potentials causing corrosion are due to alternating current that is difficult or impossible to remove at source. Application of d-c. potential for protection may be suitable. Such potential, however, should be sufficient to displace entirely the alternating current, thus giving in effect a pulsating direct current. Protection potential in this case depends upon displacing the alternating current so that the minimum potential of the structure to the soil is never less than that required for protection.

(c) In the use of modern full wave rectifiers for protection it is generally accepted that potentials never reverse. When the structure to which the current is applied contains alternating current an ordinary d-c. meter, reading average voltage, will not show whether the protection is complete or not. Also, if the rectifier is not 100 per cent efficient, reversal of potential may occur even if the structure originally contained only direct current. In an effort to determine peak voltages in connection with rectifiers, cases have been found where d-c. potentials became virtually constant at a distance from the unit but reversals in voltages actually occurred near the unit. This may have some connection with cases of corrosion occurring near units when protection appeared complete.

▼ **Alternating currents.** As mentioned in the beginning of this paper, corrosion due to alternating currents has been known since 1854. Despite the fact that most of the commercial power is alternating current it has generally been disregarded in corrosion work, although both Speller and Evans refer to its possibilities. Although considerable investigation of a-c. corrosion has been done in Europe, literature reveals little information originating in this country except from laboratories. There is a good reason for this. It can be shown by laboratory experiment that virtually any

*Presented before National Association of Corrosion Engineers, April, 1944.



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bi-metal system in an electrolyte will produce rectification when alternating current is imposed. This rectified current will measure as direct current on a d-c. meter, thus misleading the investigator if he is not looking for alternating current. It can be further shown in the laboratory that ferrous metals immersed in some electrolytes may be passivated by alternating current in apparently the same manner in which they are passivated by direct current. Several investigations have been undertaken in connection with a-c. corrosion on iron piping. Negative reports from these cases might have been due to the pipe in question being passivated.

Most ferrous metals will be passivated by either alternating current or direct current in electrolytes containing hydroxides, carbonates, chromates, and possibly other compounds. In the passivated condition the location of the iron in the electromotive series shifts so that it is negative to copper and its alloys. This phenomenon varies considerably in its aspects, depending upon the particular conditions encountered. From a commercial standpoint, however, conditions in a plant may often produce this phenomenon giving rise to that type of corrosion of copper alloys usually called dezincification. It is in reality a confusion of an electrolytic corrosion of copper with true dezincification that really implies the loss of zinc only from a copper-zinc alloy.

Non-ferrous corrosion due to alternating current is probably more common than is suspected in commercial plants and is probably particularly prevalent in water systems. With defective or poorly designed electric power circuits, water systems may pick up a considerable a-c. voltage. In such cases the common act of making the water highly alkaline to prevent ferrous corrosion actually creates a system for copper alloy corrosion. This may become apparent on brass valves, admiralty metal heat exchanger tubes, bronze pump impellers, etc. To eliminate the leakage in the power system is obviously the preferable way of solving this problem. In some cases it can also be approached from the chemical angle by a more careful control of the chemical contents of the water. At present there is insufficient data to prescribe any general method and each case must be considered individually.

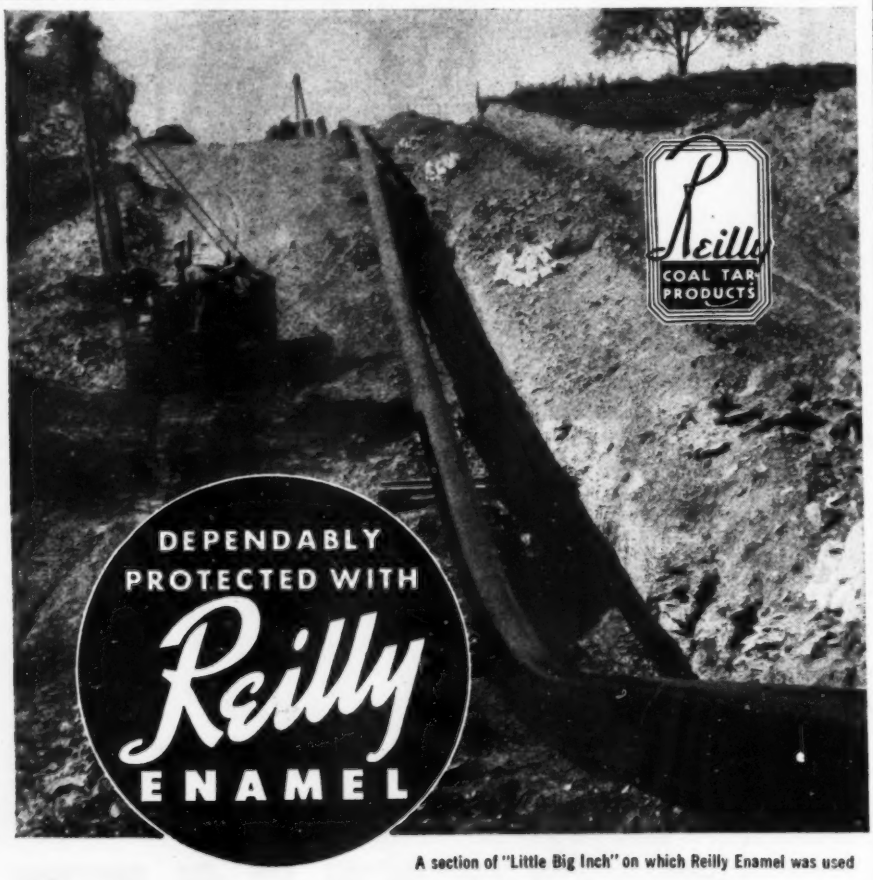
It has probably been observed by this time that this article has been confined strictly to an outline of the problems existing with pulsating currents without any details regarding methods of solving the problems. This is due to the fact that although we know the problems exist, experience in solving them in the field is limited. Much valuable information may be drawn from laboratory experimentation but proper instruments for field investigations are not obtainable. Although d-c. millivoltmeters are common, a-c. millivoltmeters are not made for general use. The only commercial instrument of any real value is the oscil-

Congress restricts sale of big pipe lines

An amendment prohibiting the sale of the Big Inch oil pipe line from Longview, Texas, to the New York harbor area or the Little Big Inch refined products line from the Beaumont-Port Arthur refinery district to New York harbor area without congressional approval was written into the war surplus property disposal bill by the House of Representatives. With the addition, the bill passed by a 58-23 vote. The amendment was sponsored by Francis E. Walter, representative from Pennsylvania.

Walter explained, in urging support of the amendment, that after the emergency has passed the two big pipe lines may be purchased by private interests and converted to the transportation of natural gas into the great industrial area along the East Coast. Use of the two big lines from Texas for transporting gas would be a knock-out blow to the coal industry, he said.

Two oil companies, Standard of New Jersey and Standard of Ohio, are potential purchasers, Walter pointed out. The Big Inch line was built by the government at a cost of $165,000,000 and the other line cost but little less. If natural gas were transported through the line and used in competition with coal, some $65,000,000 a year in relief would have to paid to coal miners who would be without employment, he concluded.



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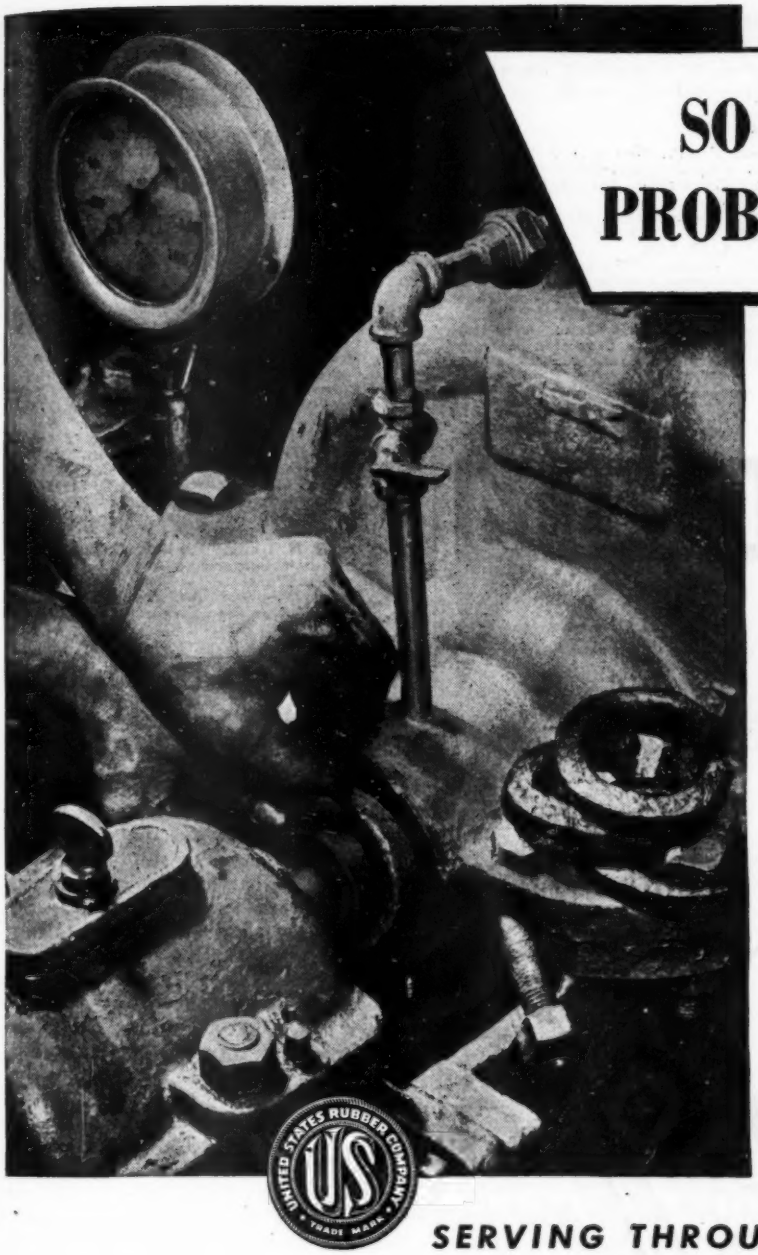

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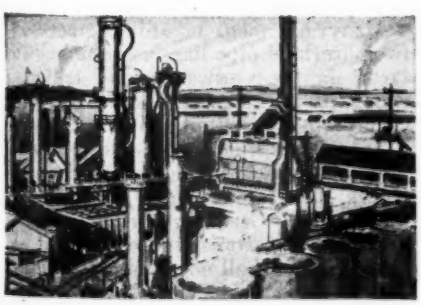

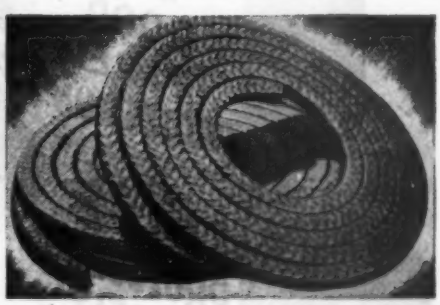

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lograph. This instrument gives direct indications of pulsating voltages, and the nature of such pulsations. It is limited to a minimum voltage required to register on the instrument. For instance, with the Dumont Type 208 oscillograph, a potential of 10 mv. is necessary to give reliable readings. For smaller potentials, an a-c. millivoltmeter is desirable. At the present time, the only apparent source of such an instrument is for the investigator to construct his own.

The whole problem of pulsating currents as regards electrolytic corrosion is one about which little is known from a practical standpoint. A consideration of the problem both as to effects and instrumentation is desirable. Such consideration by all corrosion engineers should rapidly produce a working knowledge that would be valuable to all concerned.

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Tankers are postwar factor

A postwar tanker fleet of tremendous proportions is destined to influence the future of the oil industry both in this country and abroad. J. Lewis Buckenbach, president of the American Bureau of Shipping, estimates that by the end of 1944 the emergency shipbuilding program will bring the nation's oil-carrying tonnage "close to equalling in capacity the entire world tanker fleet existing before the war." The American Merchant Marine Institute estimates postwar American tanker holdings at 1,070 ships of 15,000,000 tons, excluding war losses and transfers. This is in contrast to global tanker tonnage in 1939 of about 17,000,000 tons.

Before the war five major operating nations, Britain, the United States, Norway, Holland, and Panama, controlled about 78 per cent of the world's oil carriers. The United States, however, has been the only nation able to meet its large losses by sufficient new building to retain its prewar position.

Many oil men regard competition from overland pipe lines as an unknown factor in the postwar use of tankers, which in prewar days carried 95 per cent of the oil supply to eastern seaboard states from the Southwest and South American fields. Charles H. Kunze, general manager for Socony-Vacuum Oil Company's marine transportation department observed: "It is clear that we shall not need all the pipe lines and all the new tankers for supplying the east coast market. New tankers should not be laid up and allowed to rust. The surplus should be offered for sale or charter to our allies."

B. B. Howard, Standard Oil Company of New Jersey general manager for marine operations, urges government determination of the size of the postwar tanker fleet size "with first consideration being given to our national and economic security requirements, and surplus tonnage to be disposed of to foreign interests or scrapped."

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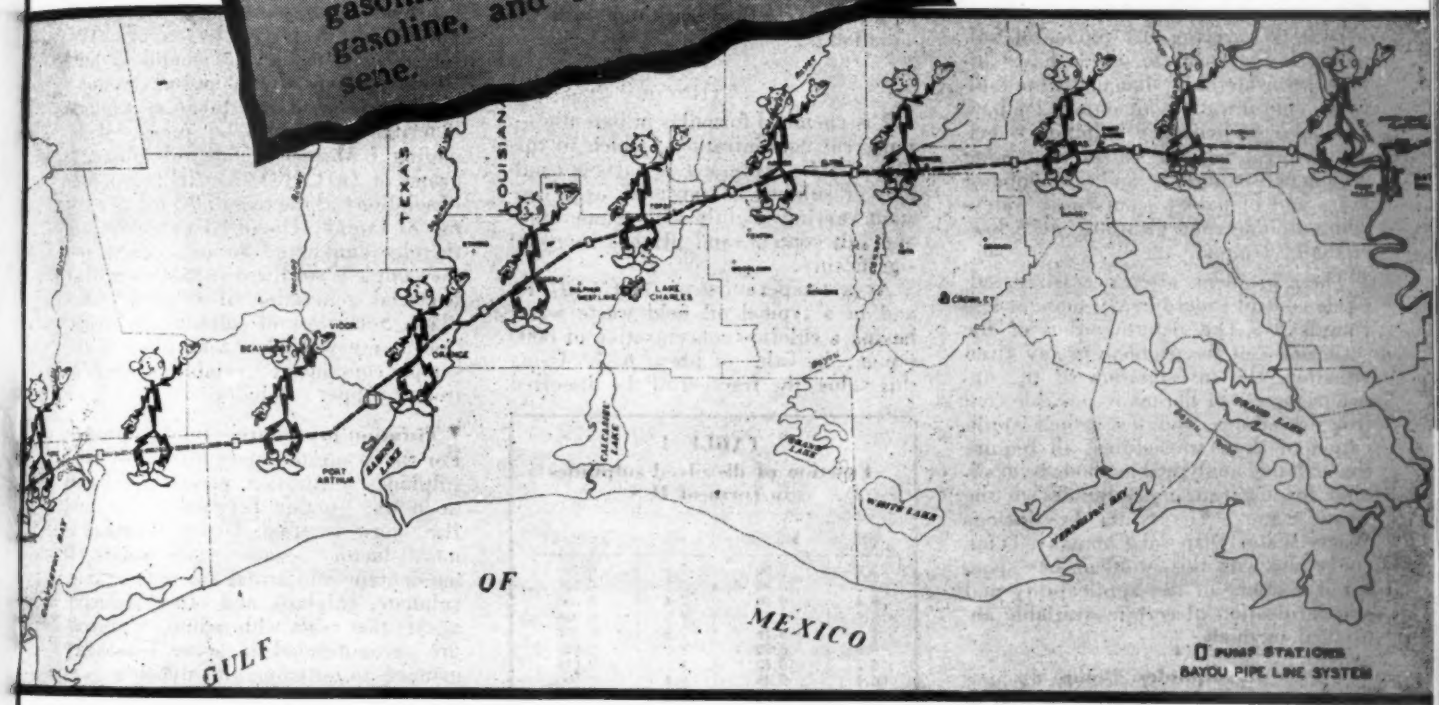
Bayou Pipe Line System set a new delivery record for July by pumping a daily average of 64,569 bbl. of products from the Houston-Texas City and Beaumont-Port Arthur refineries into the Plantation Pipe Line terminal at Baton Rouge. Products moved in the 31-day period included 1,492,443 bbl. of housebrand gasoline, 397,737 bbl. of premium gasoline, and 111,479 bbl. of kerosene.



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Determination of Sulphides In Petroleum Waste Waters

By RICHARD POMEROY†
Consulting Engineer

EXCLUSIVE SULPHIDES in oil field and refinery waste waters give rise to many problems, including odors, blackness of the water, corrosion of metals submerged in the water, corrosion of concrete surfaces above the water, blackening of paints, and tarnishing of copper and its alloys. Corrosion of iron has been a problem in waters carrying 0.5 p.p.m. of sulphide. Large concrete sewers have suffered considerable damage from sulphide concentrations of only 0.2 p.p.m. The odor of hydrogen sulphide is evident around natural waters containing 0.1 p.p.m. of sulphide, and tarnishing of brass and of paints occurs near waters with sulphide concentrations much lower than 0.1 p.p.m.

These problems often necessitate sulphide control procedures of more or less complexity. The determination of the seriousness of the problem in any given situation, the investigation of the appropriateness of the many possible control procedures, and the proper application of these procedures, all require that suitable analytical methods be available for determining sulphides in the waste waters. The Santa Fe Springs Waste Water Disposal Company, being concerned with this problem, has sponsored a study of the applicability and standardization of certain available analytical methods.

▼ **Forms of sulphides.** Before discussing the analytical tests, it is essential to call attention to the various forms of inorganic sulphides that may be present in waste waters. (Mercaptans and other organic sulphur compounds are not considered in this article). The forms of inorganic sulphides are: Un-ionized hydrogen sulphide (H_2S), hydro-sulphide ion (HS^-), and insoluble sulphides.* The sum of H_2S and HS^- is referred to as dissolved sulphides, and the sum of all three forms as total sulphides. The insoluble sulphides are chiefly iron sulphides, (FeS and FeS_2), with occasional traces of the sulphides of zinc, copper, lead, and other metals, but sometimes large amounts of these latter sulphides are present when these metals are used in control procedures. Pertinent properties of these insoluble sulphides are shown in appendix of this article.

Hydrogen sulphide, hydrosulphide ion, and hydrogen ions are in equilibrium in any solution containing dissolved sulphides. The equilibrium reaction is shown by the equation:

$$H_2S \longleftrightarrow H^+ + HS^-$$

In accordance with the well known laws of mass action, a mathematical equation may be set up relating the concentrations of the components of the equilibrium. In the logarithmic form the equation is:

$$\log \frac{(H_2S)}{(HS^-)} = pK - pH$$

The chemical formulas in parentheses represent concentrations, which in this case may be expressed as parts per million of sulphur content; pK is a constant varying slightly with temperature and salt content, and pH has its usual significance.

At a temperature of 35°C. (97°F) and in a typical oil field waste water having a chloride concentration of 8000 p.p.m., the value of pK is 6.37.[1] Using this value, the fraction of the dissolved sulphides in the form of H_2S may be calculated, with results as shown in Table 1. This table is applicable with negligible errors at temperatures between 30° and 40°C., and with chloride concentrations from 5,000 to 12,000 p.p.m.

TABLE 1
Fraction of dissolved sulphides in form of H_2S

pH	Fraction	pH	Fraction
5.0	0.96	7.0	0.19
5.2	0.94	7.2	0.126
5.4	0.90	7.4	0.085
5.6	0.85	7.6	0.056
5.8	0.78	7.8	0.036
6.0	0.70	8.0	0.023
6.2	0.60	8.2	0.015
6.4	0.48	8.4	0.0093
6.6	0.37	8.6	0.0059
6.8	0.27	8.8	0.0037

For conditions not within these prescribed limits, a term may be added to the actual observed pH to give what may be called an effective pH for use in Table 1. Values of this correction term are shown in Table 2.

It has been customary in the past to report all sulphide determinations as hydrogen sulphide. The writer is not one who wishes unnecessarily to change the customary usage of terms, but, because it is important in sulphide control investigations to distinguish between the different forms of sulphides, it is desirable to abandon this inexact use of the term hydrogen sulphide. If the designation hydrogen sulphide is used when dissolved sulphides is meant, what shall be used when hydrogen sulphide is meant?

▼ **Sampling difficulties.** Serious errors may be incurred by careless handling of samples for sulphide determinations, because of the rapidity with which sulphides are destroyed by oxygen. Dissolved sulphide analyses should be started immediately after sampling. Samples that will be used only for total sulphide determinations may be preserved by adding 1 M zinc acetate solution (220 grams of $Zn(C_2H_3O_2)_2 \times 2H_2O$ per liter of solution) at the rate of 0.5 ml. per 100 ml. of sample. Dissolved sulphides are thereby converted to inert ZnS, and the sample is sterilized so that no further bacterial generation of sulphide takes place. Some loss of sulphide by oxidation may nevertheless take place if the sample contains appreciable amounts of iron or copper sulphides.

▼ **Titration procedure—total sulphides.** For the accurate determination of total sulphides a titration procedure, based upon the reaction between iodine and H_2S, must be used. Direct titration is unsatisfactory because waste waters often contain substantial amounts of thiosulphate, sulphite, and other reducing agents that react with iodine. A procedure recommended in some laboratory manuals to overcome this difficulty is to acidify the sample, then bubble a stream of inert gas through it and into a zinc acetate receiving solution. This transfers H_2S from the sample to the receiving solution where it then can be titrated without interference.[2] If the sample contains sulphite, it is not permissible to add strong acid, for this brings about reactions between H_2S and SO_2, forming thiosulphate or sulphur. Buffering the solution to a pH between 6 and 7 is satisfactory in these cases. On the other

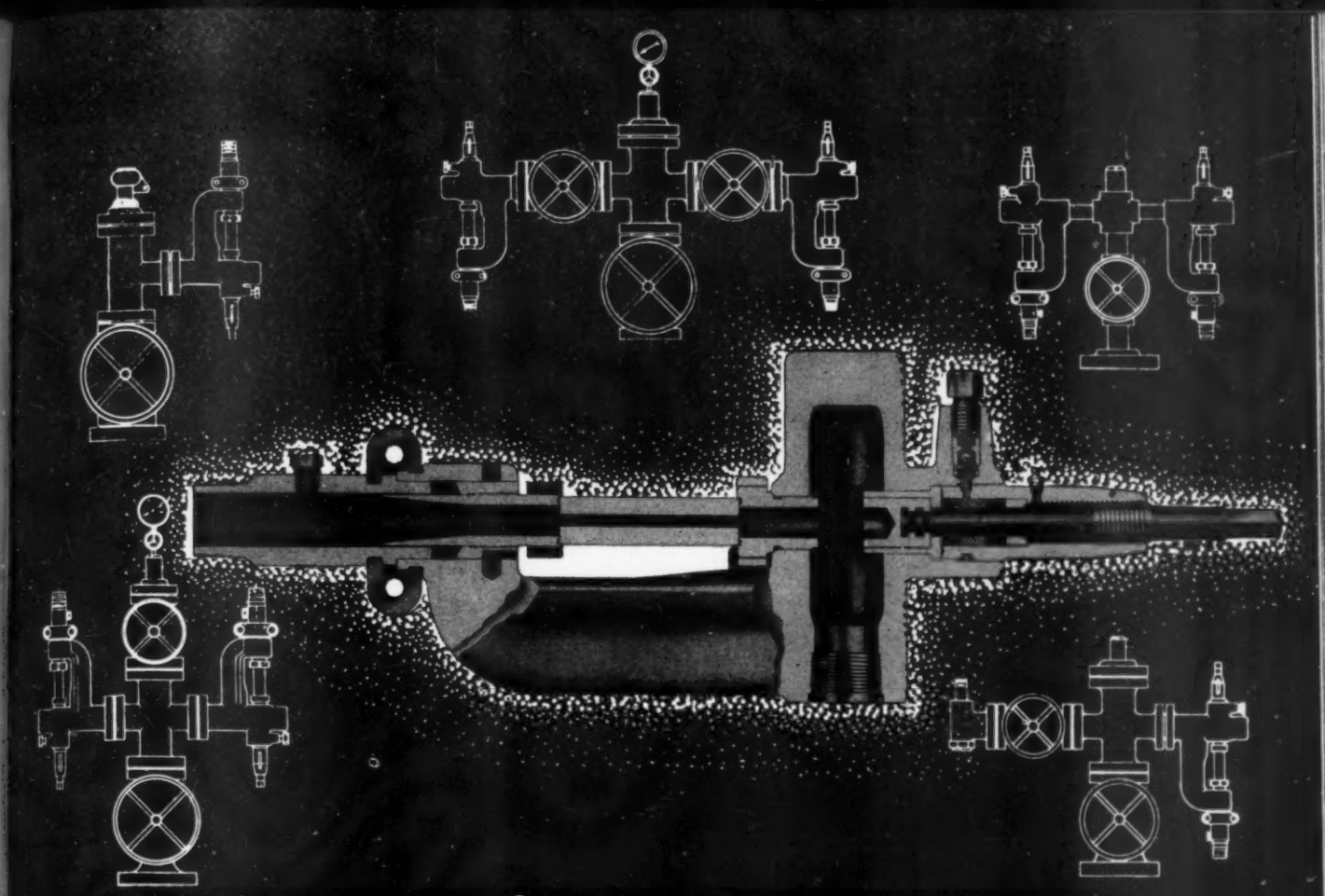
TABLE 2
Term to be added to observed pH to give "effective pH" for use in Table 1

Chloride,* p.p.m.	20°C.	25°C.	30°C.	35°C.	40°C.	50°C.	60°C.	70°C.
1,000	−0.38	−0.31	−0.23	−0.16	−0.09	+0.06	+0.20	+0.35
2,000	−0.34	−0.27	−0.20	−0.13	−0.05	+0.09	+0.24	+0.38
4,000	−0.29	−0.22	−0.15	−0.07	−0.00	+0.15	+0.29	+0.44
6,000	−0.25	−0.18	−0.11	−0.03	+0.04	+0.18	+0.33	+0.28
8,000	−0.22	−0.15	−0.07	−0.00	+0.07	+0.22	+0.36	+0.51
10,000	−0.19	−0.12	−0.04	+0.03	+0.10	+0.25	+0.39	+0.54
15,000	−0.13	−0.05	+0.02	+0.09	+0.16	+0.31	+0.46	+0.60
20,000	−0.07	0.00	+0.07	+0.14	+0.22	+0.36	+0.51	+0.66
30,000	+0.01	+0.08	+0.16	+0.23	+0.30	+0.45	+0.59	+0.74

*The effect of dissolved salts depends upon the ionic strength. For typical oil field waste waters it is estimated that one unit of ionic strength corresponds approximately to 32,000 p.p.m. of chloride. The table is calculated on his basis.

†Dr. Pomeroy acts as consultant on chemical matters for Santa Fe Springs Waste Water Disposal Company.

*The amount of sulphide ion, $S^=$, is negligible unless the pH is above 12.



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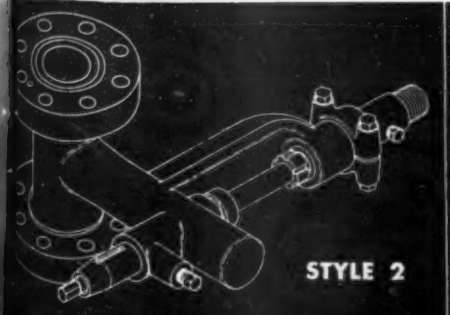
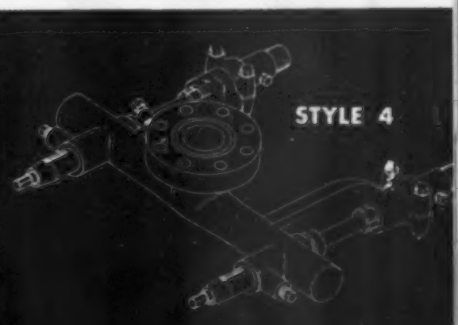


Tee Type Flow Wing for installation in vertical run of Xmas tree

Cross Type Flow Manifold for installation in vertical run of Xmas tree



Tee Type Flow Manifold for installation in horizontal run of Xmas tree

hand, if the sample contains ZnS, FeS_2, or other difficultly soluble sulphides, strong acid is required. If the sample contains metallic sulphides and sulphite, it is not possible to carry out a quantitative transfer of H_2S to the receeiving solution.

In the research of the Santa Fe Springs Waste Water Disposal Company, a new modification of the titration method has been developed. In this procedure, sulphides are precipitated by adding zinc acetate, and the non-sulphide iodine demand is determined by titration of an aliquot.

Procedure: Select a bottle size that will hold a quantity of sample suitable for titration—preferably a liter for sulphide concentrations below 10 p.p.m., 250 ml. for concentrations of 10-25 p.p.m., and 100 ml. for concentrations of 25-100 p.p.m. Add to the bottle 1 M zinc acetate solution (220 grams of Zn ($C_2H_3O_3$) $\times$ $2H_2O$ per liter of solution) in the proportion of 0.5 ml. per 100 ml. of capacity. Fill the bottle with sample, taking care to minimize aeration; then add 1 M sodium carbonate solution (106 grams of Na_2CO_3 per liter of solution) in amount equal to the volume of zinc acetate used. Rotate the bottle back and forth about a transverse axis to flocculate the contents. Allow the mixture to stand until the precipitate settles and supernatant liquid clears.

Siphon off clear liquid in amount equal to exactly half of the volume of the bottle, and transfer this to a flask containing a little water acidified with 1-2 ml. of acetic acid. Add an excess of N/40 iodine solution, then back-titrate with N/40 thiosulphate, using starch solution as an indicator. From the carefully determined ratio of strengths of the iodine and thiosulphate solutions calculate the net volume of iodine consumed.*

To the liquid and precipitate remaining in the bottle add a volume of N/40 iodine solution equal to the volume consumed in the first titration plus an amount in excess of the requirement for reaction with the maximum quantity of sulphide thought likely to be present. (One ml. of N/40 iodine solution will react with 0.4 mg. of sulphide.) Add slowly, with vigorous stirring, 5 ml. of 6 N HCl (concentrated HCl diluted with an equal volume of water), then back-titrate with thiosulphate. Calculate the net volume of iodine consumed in this titration. Subtract from this the volume of iodine used in the first titration, as representing the non-sulphide iodine demand. The difference multiplied by 0.4 gives the milligrams of sulphide in the sample. Calculate the number of milligrams per liter and report as p.p.m of total sulphides. (Note that the volume of sample was 1 per cent less than the capacity of the bottle, because of the addition of reagents.)

It is evident that variations of this method are possible. The volume of clear liquid used in the first titration need not be just half of the contents of the bottle, provided suitable factors are used in the subsequent calculations. If the sulphide content is low compared to the non-sulphide iodine demand, then it is desirable to draw off as much as possible of the liquid for the first titration. In some cases it may be preferable to filter the precipitate on asbestos, washing away all soluble interfering substances, then to transfer the crucible to a beaker where the precipitate is titrated. When this is done the first titration for non-sulphide iodine demand is unnecessary. This should not be done, however, if significant amounts of iron sulphides or other reactive sulphides are present, because these may be destroyed by oxidation. Sodium carbonate may be omitted if the alkalinity of the sample is sufficient to bring down a good precipitate, leaving the supernatant clear.

If the sample contains suspended solids capable of reacting with iodine, other than sulphides, such solids will tend to cause high results, but this is not often a serious factor in the analysis of petroleum waste waters except when sulphide concentrations are very low. In general, the method can be made to yield results of good accuracy with samples of a wide variety of types.

▼ **Dissolved sulphides.** If the sample contains no suspended matter, then total

*For the preparation and standardization of iodine, thiosulphate, and starch solutions, see any standard laboratory manual of analytical chemistry.

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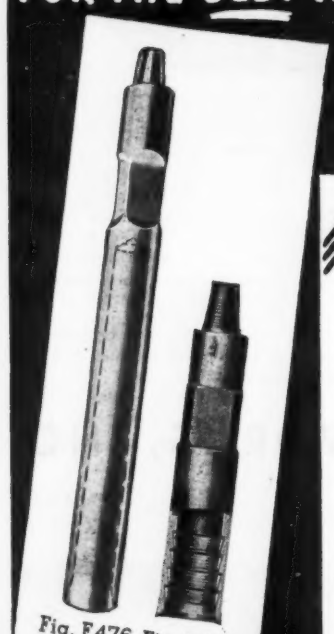

Fig. F476 Fig. F481

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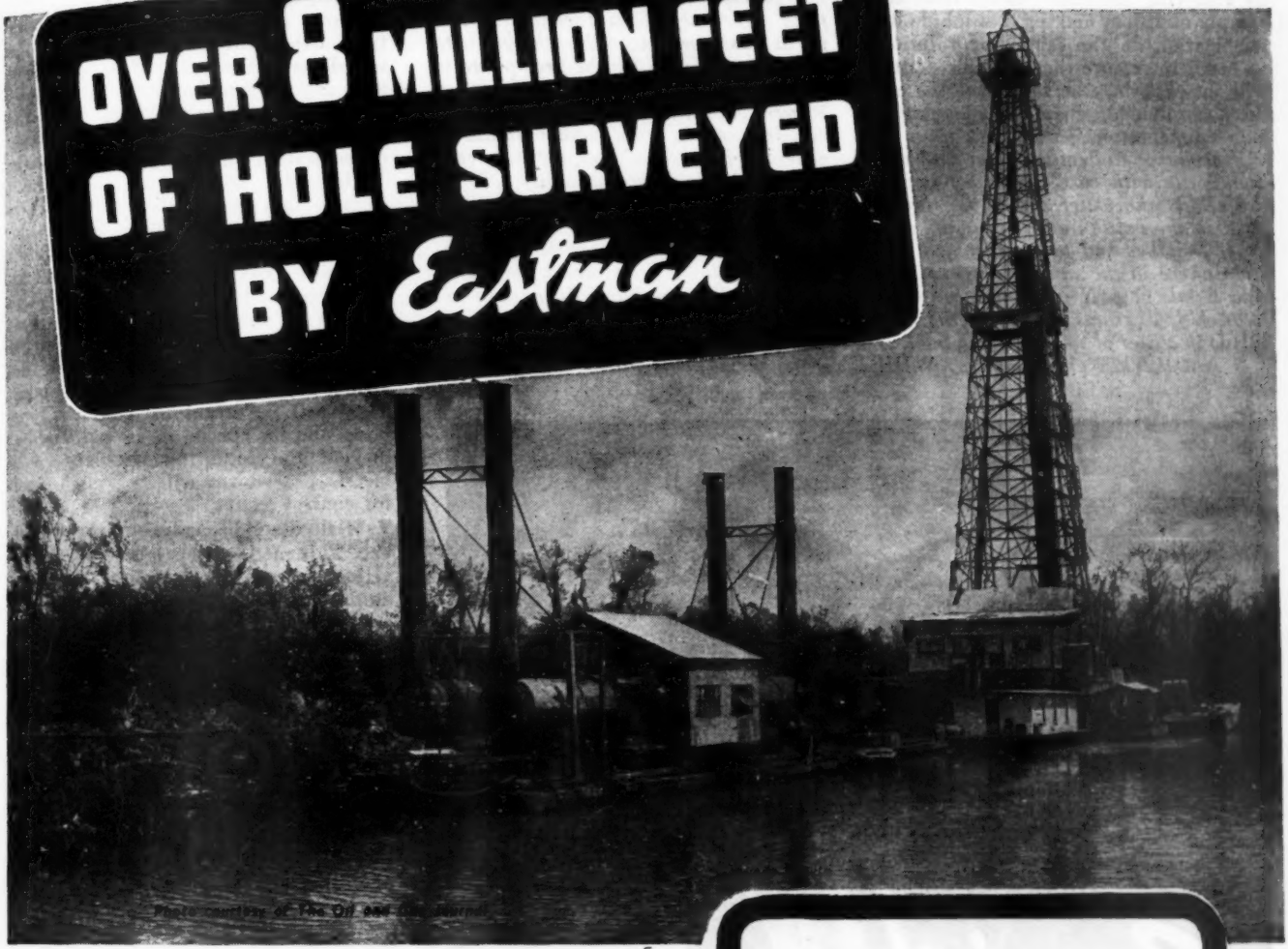

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sulphides = dissolved sulphides. Otherwise dissolved sulphides are determined by removing insoluble matter from the sample and then making a sulphide determination on the remaining solution. In order to remove the insoluble matter without exposing the sample to the air, the technique of chemical coagulation and sedimentation is used.

Procedure: Collect the sample in a 1-liter bottle with care to avoid aeration. Preferably the water should be flowed through the bottle until it contains only water that has had no contact with the atmosphere in the sampling operations. Add 5 ml. of 3 N aluminum sulphate solution (340 grams of c.p. $Al_2(SO_4)_3 \times 18H_2O$ in a liter of solution) and 5 ml. of 3 N NaOH (125 grams of c.p. NaOH pellets in a liter of solution). Stopper tightly with no air bubbles. Flocculate the precipitate by rotating back and forth vigorously about a transverse axis for at least a minute. Allow the bottle to stand long enough for the precipitate to settle. This should not require more than 30 min. A small amount of turbidity remaining in the supernatant liquid is generally inconsequential, for the metallic sulphides in this turbidity will be only a very small fraction of the total in the sample.

Analyse a suitable portion of the supernatant liquid from which the insoluble metallic sulphides have been removed, using the same procedure that is used for determining total sulphides, or any other suitable procedure. A correction of plus 1 per cent is necessary to compensate for dilution of the sample by the coagulating chemicals.

Errors in this procedure may result from oxidation. During the time the sample is settling, sulphides will react with any oxygen that may have gained access to the sample. Even with the utmost care in sampling, the sulphide concentration may undergo changes during the settling period, which changes may be merely a continuation of reactions in progress before the sample was taken. If research purposes demand maximum accuracy, special filtration techniques may be employed to shorten the period elapsing before titration.

These titration procedures are designed for accuracy rather than speed. They will be useful for research purposes and for special investigations, but one of the following simpler colorimetric procedures will be relied upon for control testing.

▼ **Methylene blue colorimetric procedure.** This method depends upon the reaction between para - amino - dimethyl - aniline, chloride ion, and sulphide in acid solution to produce the dye methylene blue. Because of its simplicity and sensitivity to very low sulphide concentrations, it is the principle method now used for the determination of sulphides in sewage. Details of the procedure have been published elsewhere[1,2] and need not be repeated here. A commercial test kit with instructions is on the market.

Sulphides of iron, zinc, cadmium, and lead react readily in the test, but sulphides of copper, mercury, silver, and other extremely insoluble sulphides do not react. Thus if much copper is present results for total sulphides will be low. Organic sulphides do not interfere.

The application of this method to the measurement of sulphides in oil field waste water is hampered by the presence of iodide, which causes the appearance of a lavender color, and deficient development of the blue color. This interference is not serious unless the iodide concentration is more than five times the sulphide concentration. Deficient color formation may also result from sulphites and thiosulphates in excess of 20 p.p.m., and extremely high sulphide concentrations, as in caustic wash water from refineries, will entirely prevent color formation.

These interferences can be overcome by the following technique.

Procedure: To a 100-ml. bottle of the sample add 0.5 ml. of 1 M zinc acetate solution and 0.5 ml. of 1 M sodium carbonate solution. Flocculate the mixture by rotating the bottle back and forth about a transverse axis, then allow the precipitate to settle until the supernatant liquid is clear. Siphon off and discard as much as possible of the liquid without removing any of the precipitate. Then refill the bottle with tap water to within 1 ml. of the top (as the original sample was 1 ml. less than the volume of the bottle.) Suspend the precipitate in the water by shaking, and withdraw a sample for analysis.

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By these operations the concentrations of interfering substances are generally reduced sufficiently so that the analysis will give reliable results, but if one such cycle of operations does not suffice, the settling, drawing off, and refilling may be repeated to further wash out the undesirable constituents.

If the sulphide concentration is low, it may be desirable after settling the sulphide precipitate to make up to a volume smaller than the original sample size. Thus, for example, if the mixture is made up to a volume one tenth as great as the original, the sulphide concentration will then be 10 times as great and the result of the subsequent analysis will be divided by 10 to give the concentration in the original sample.

To determine dissolved sulphides, insoluble sulphides are first removed from the sample by the method described under "titration procedures," except that a sample size of 100 ml. and correspondingly smaller volumes of flocculating reagents may be used, because the test requires only 15 ml. of sample.

The methylene blue method is applicable for determinations of total sulphides when a method faster than titration is desired, and it is especially useful for very low sulphide concentrations. It will permit direct measurement from 0.1 to 20 p.p.m., and by the foregoing technique of concentrating it can be used to measure vanishingly small amounts of sulphide. Under ordinary conditions of use, with visual color comparisons, one may expect the errors to average ± 10 per cent. For measuring sulphide concentrations below 1.0 p.p.m., especially in the presence of much suspended matter, it is generally more accurate than the titration procedure.

▼ **Antimony colorimetric method.** Several colorimetric methods have been based upon the formation of metallic sulphide precipitates. None is very accurate, but they are often useful for control purposes. The best method in this category is the antimony method, in which the addition of an antimony potassium tartrate solution to the sample produces an orange color proportional to the sulphide content.

Insoluble metallic sulphides will not react appreciably with the antimony solution. In an attempt to use this method to measure total sulphides, it has been common practice to add HCl in the amount of 1 ml. of 6 N acid per 100 ml. sample. This is supposed to dissolve the metallic sulphides so that they will react. The technique is satisfactory as far as FeS is concerned, but ZnS and FeS_2 dissolve only very slowly in acid of this concentration. Larger amounts of acid will bring ZnS into reaction, but not PbS and other less soluble sulphides. High acid concentrations have the disadvantages that they cause sulphide to react with sulphite; they decompose thiosulphate with formation of sulphide, and they may hinder the formation of the antimony sulphide color. Because of these difficulties, it seems unwise to attempt to use the antimony method for total sulphide determinations.

By using the antimony method without making the sample strongly acid, however, a simple procedure is available for estimating dissolved sulphides. As this is the result that is generally of the greatest significance in sulphide control problems, there is an important field of usefulness for this method.

Because of the amphoteric nature of antimony sulphide, complete precipitation does not occur at high pH values. At pH 8.5 the color development will be deficient in measuring low sulphide concentrations, and at 11.0 little or no color appears even at quite high sulphide concentrations. Hence acid must be added if the pH is above 8.0. If considerable amounts of insoluble sulphides are present, and if much strong acid is added, enough of the insoluble sulphides may be brought into solution to cause an error in the dissolved sulphide determination. Therefore the acidification is best done by adding a small amount of acetic acid. For proper color development it is necessary to mix the antimony solution with the sample first, and then add the acid.

Procedure: If the sample contains much suspended matter that would interfere with observation of the color, remove this by settling. (If necessary, use aluminum sulphate and sodium hydroxide solutions to coagulate the suspended matter in the manner described under "dissolved sulphides" in the discussion of titration procedures.) Put 1 ml. of saturated antimony potassium tartrate solution in a test tube of 1¼-1½ in. diam., followed by about 100 ml. of the sample. Then add 1 ml. of 6 N acetic acid (370 ml. of the pure acid diluted to a liter.) If the original alkalinity of the sample exceeds 0.06 N (3000 p.p.m. as $CaCO_3$), it may be necessary to add more acid, so that the final pH is not higher than 8.0. Compare the color with permanent standards prepared as described hereinafter.

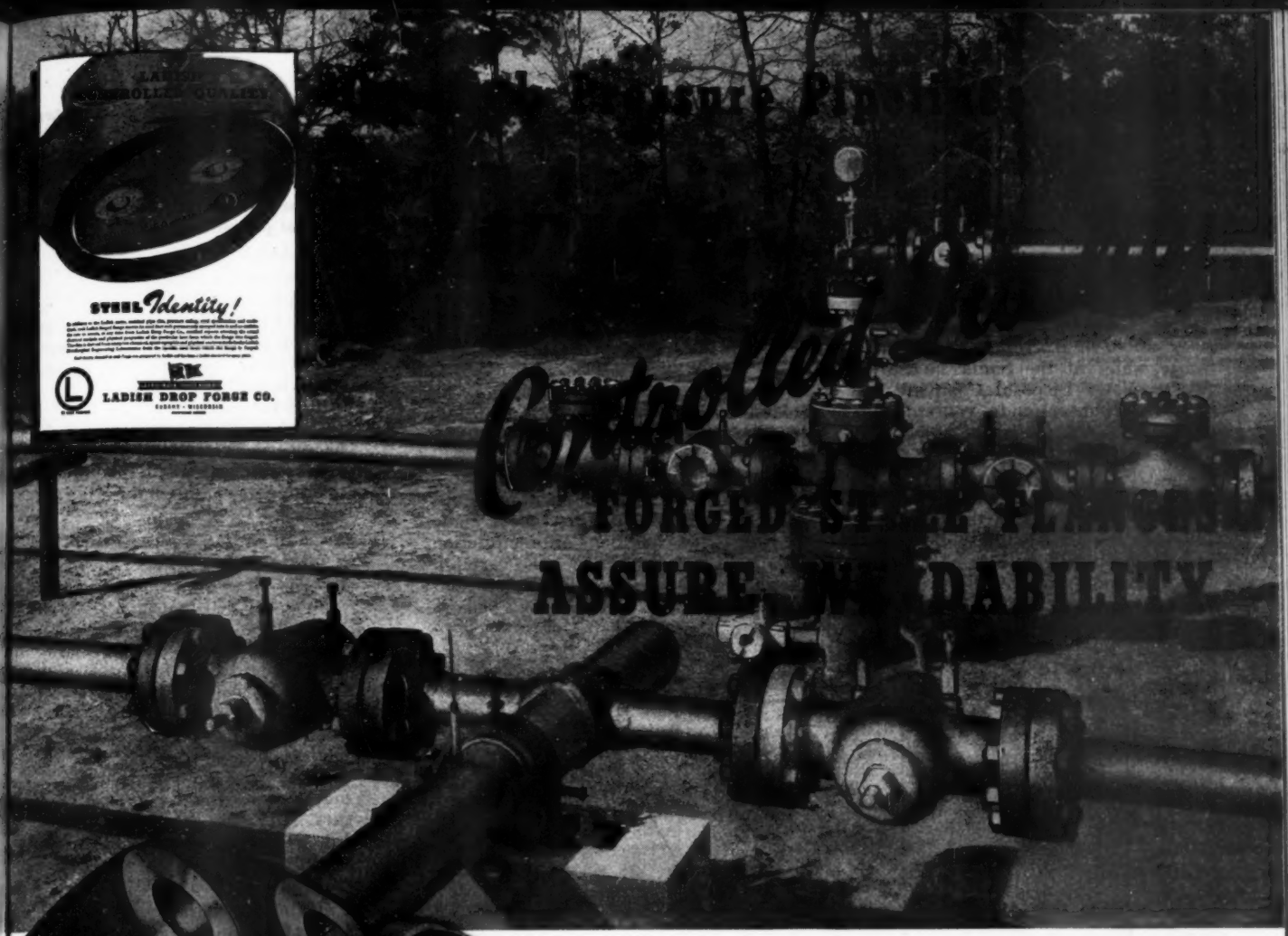
If the sample is appreciably colored or turbid, compensating tubes should be used in a block comparator arrangement.

If sulphides exceed 10 p.p.m., dilute the sample by first adding the antimony solution and measured volume of water to the test tube, followed by a measured

Oil movie released

Filmed in technicolor, the new sound and color motion picture recently finished by the Interstate Oil Compact Commission is now ready for free industrial and civic showings. It was taken in 13 oil producing states, has 250 scenes and takes 30 minutes to show. It unfolds the story of oil from its prehistoric origin to modern times.

The picture was premiered at the Commission's Spring meeting in New Orleans. Applications for free showings before civic, industrial and educational groups should be addressed to the Commission headquarters at Oklahoma City, Oklahoma.



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volume of sample. Multiply the apparent sulphide content by the dilution ratio. Report results as dissolved sulphides.

Solutions of potassium chloroplatinate are suitable for preparation of permanent standards. This compound matches the color of the antimony sulphide precipitate much better than potassium dichromate, which has been recommended in the past.

A series of 52 samples of clarified waste water at the Santa Fe Springs Waste Water Disposal Company, having dissolved sulphide concentrations from 0.5 to 25 p.p.m. were tested by titration and by the colorimetric procedures. Observations were made of the concentrations of potassium chloroplatinate required to match the colors produced in the antimony test. Results are shown graphically in Fig. 1. It appears that the color produced by 1 p.p.m. of sulphide corresponds to potassium chloroplatinate at a concentration of 370 p.p.m. A stock solution of K_2PtCl_6 can be made at a concentration of 3.70 grams per liter (3700 p.p.m.) to represent 10 p.p.m. of sulphide, and this solution can be suitably diluted to make standards for sulphide concentrations down to 0.5 p.p.m. Standards made in this way and sealed in glass will not change appreciably in 3 years.

Direct readings above 10 p.p.m. are not practical because of the turbidity of the Sb_2S_3 precipitate.

Some erratic variation seems to be inherent in the antimony method. The data represented in Fig. 1 show that deviations may be expected to average ± 17 per cent in clarified waters. In turbid or colored waters variations may be even greater. Attempts have been made to control the conditions of precipitation in such a way as to reduce the variability of the color produced in the test[4], but such procedures are not of great benefit.

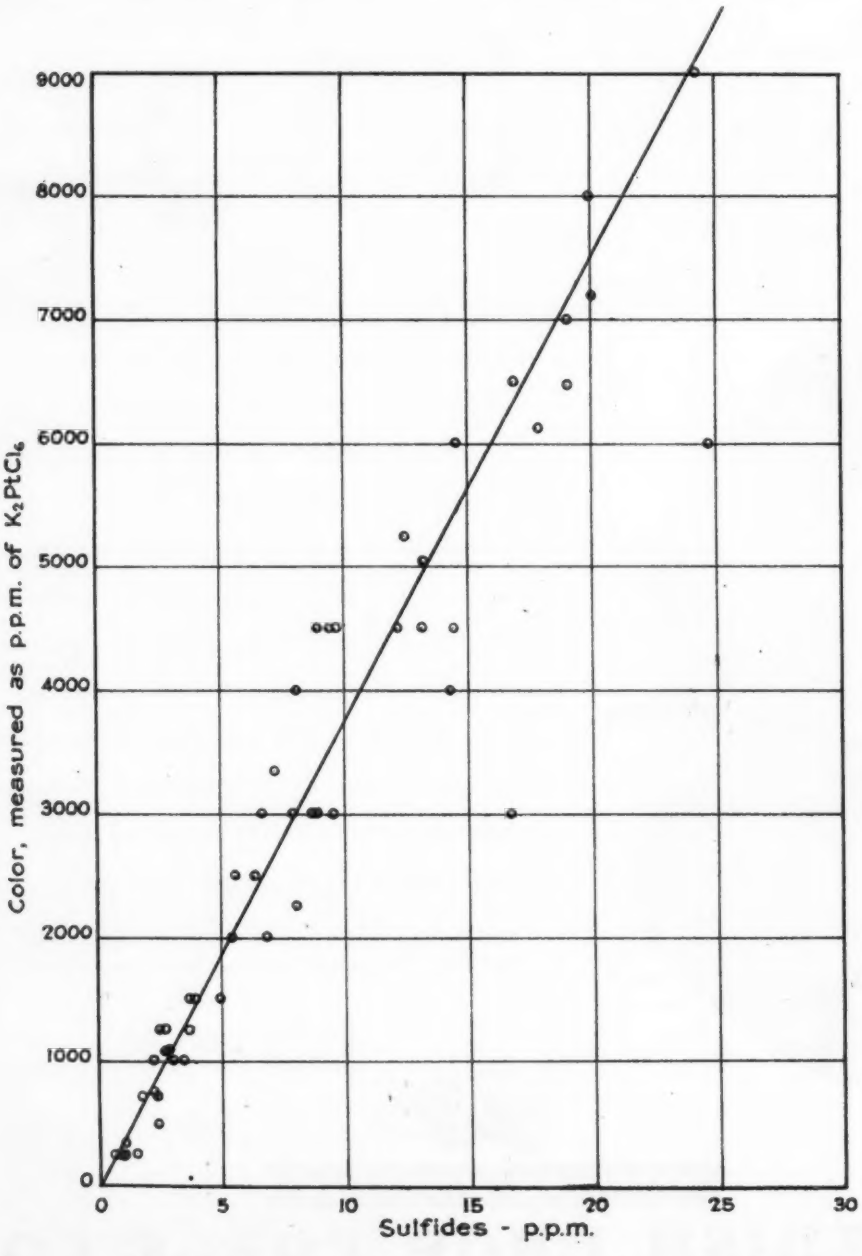

Fig. 1 - Color Produced In Antimony Tests For Sulfides

The appropriate fields of usefulness of the procedures that have been described are shown in the following outline.

▼ Summary of the applications of the various test procedures.

Total sulphides

For maximum accuracy:

Precipitation-titration method, except for sulphide concentrations below 1.0 p.p.m., which may be more accurately determined by the methylene blue method.

For moderate accuracy:

Methylene blue method, preceded if necessary by zinc precipitation to concentrate very small quantities or to eliminate soluble interfering substances.

Dissolved sulphides

For maximum accuracy:

Remove suspended matter by coagulation and settling, then apply the precipitation-titration method, or precipitation followed by methylene blue method for low concentrations.

For approximate results:

Direct application of antimony method, unless sample is very turbid, in which case preliminary removal of suspended matter is necessary. This is the most generally useful sulphide test for petroleum waste waters.

Hydrogen sulphide

For maximum accuracy:

Determine concentration of H_2S in an inert gas brought to equilibrium with the sample.

For approximate results:

Determine dissolved sulphides and pH by any suitable means, and calculate the concentration of H_2S.

Appendix

Properties of metallic sulphides.

Ferrous sulphide—FeS: Black. Is oxidized rapidly by the slightest traces of oxygen, giving FeS_2 and then free sulphur. Dissolves easily in acid.

Iron disulphide—FeS_2: Commonest metallic sulphide in waste waters. Black when finely divided; brass colored when massive. Oxidizes fairly rapidly when in a finely divided state, giving sulphur. Dissolves slowly in acid. Only one-half of the sulphur in this compound is to be considered sulphide sulphur, for upon treatment with acid the reaction is:

$$FeS_2 + 2\,H^+ \longrightarrow Fe^{++} + H_2S + S$$

Lead sulphide—PbS: Black. Oxidizes slowly, giving sulphur. Dissolves with difficulty in strong acid.

Cupric sulphide: Black. Oxidizes rapidly, giving sulphur. Insoluble in acids except oxidizing acids such as HNO_3, or in presence of an oxidizing agent such as iodine.

Zinc sulphide—Zns: White, Immune to oxidation. Dissolves readily in moderate acid concentrations.

Antimony sulphide—Sb_2S_3: This is the orange compound produced in the antimony test for sulphides. Immune to oxidation. Dissolves in concentrated HCl and in dilute NaOH.

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1. "Hydrogen Sulfide in Sewage," by Richard Pomeroy. *Sewage Works Jour. 13,* 498-505 (1941).
2. American Public Health Association, *Standard Methods for the Analysis of Water and Sewage.* Eighth edition, 1936, p. 168.
3. American Public Health Association, *Standard Methods for the Analysis of Water and Sewage.* Ninth edition (in press).
4. "A Comparison of Two Methods for Determination of Hydrogen Sulfide in Sewage," by Harry E. Johnson, *Sewage Works Jour. 3,* 205-9 (1931).

★ ★ ★

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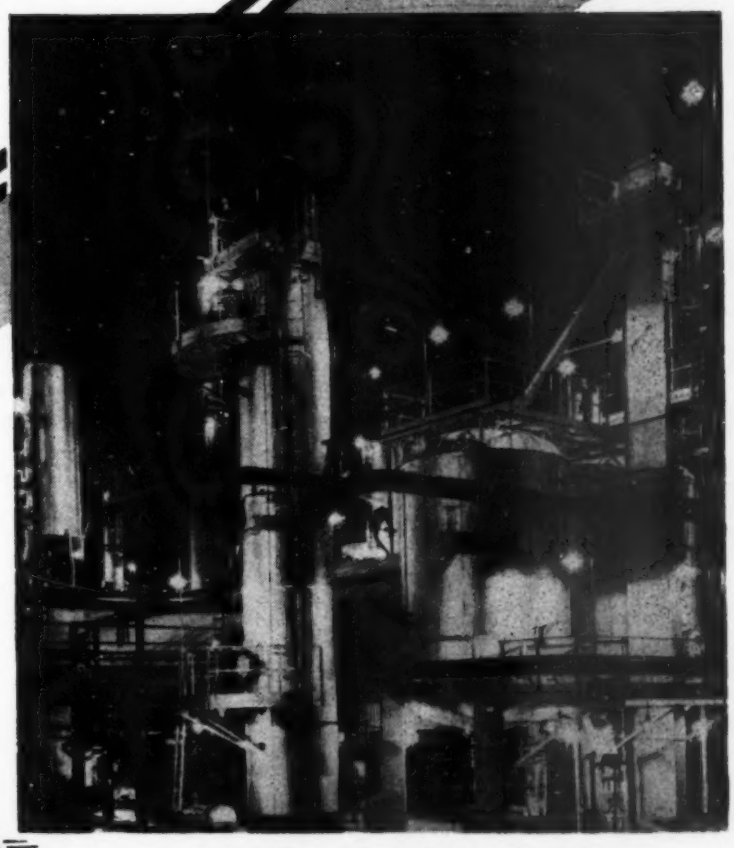

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Optimum Time to Bail and Wash Wells Producing Silt*

By J. R. STITT†

THE curves discussed herein regarding the optimum time to bail and wash wells were developed soon after the state curtailment program on oil production was removed from the Fruitvale field, near Bakersfield, California.

In this particular field the producing horizons are composed of unconsolidated sands containing considerable fine silt or clay. The silt is carried with the flow of oil, which is of low gravity and particularly viscous, through the formation into the vicinity of the well bore where a portion of the silt accumulates progressively plugging the formation and liner perforations. This deposition causes a decrease in the productivity of the wells and results in apparent well declines as high as 50 per cent a month.

Under curtailment, this condition was not particularly serious, because the wells were produced at reduced rates or shut down from a quarter to a third of each month. Also, after these shut down periods, a natural washing action probably occurred due to the flush production or higher rates of flow immediately after a well was placed on production.

However, with the gradual increase in oil allotment to the field and the final removal of all curtailment it became necessary to produce the wells continuously at maximum rates. This resulted in high well declines, due to silting, which in turn resulted in a serious over all loss in field production.

A well production curve showing a typical high rate of decline is plotted on Fig. 1. This curve also illustrates the need for some method of determining the optimum time interval between bailing and wash jobs, so as to produce a total volume of oil that would result in the highest monetary returns. For example, on the curve, the two intervals shown between the wash jobs are approximately 6½ months and 2 months. The problem presented was to determine whether either of these time intervals resulted in the maximum returns from the production of the well and if not what should have been the time interval. To go to extremes, if the wash jobs were successive to each other, no oil would have been produced and on the other hand if the well was permitted to decline without washing only a portion of the oil would have been produced.

In setting up the problem it was apparent immediately that the solution for one well would not be the answer for all wells unless they were all identical as to decline and production rates; that is, a 150-bbl. well that declined 50 per cent a month would have to be pulled more often than a 150-bbl. well that declined only 10 per cent a month. Also, a 50-bbl. well that declined 50 per cent a month could not be pulled as often as a 150-bbl. well with the same decline, since the increase in production would not be as great and the pulling expense for all wells remains more or less constant.

A family of curves for each of several rates of production using various rates of well decline were plotted as shown on Fig. 2. These curves show the theoretical number of barrels of oil production lost, due to silting, for a hypothetical well producing a maximum of 130 bbl. a day. The "Time" scale indicates the days the well is on production between wash jobs and the minimum point on the curves represents the optimum time interval to produce a well, prior to washing, for the least loss of revenue.

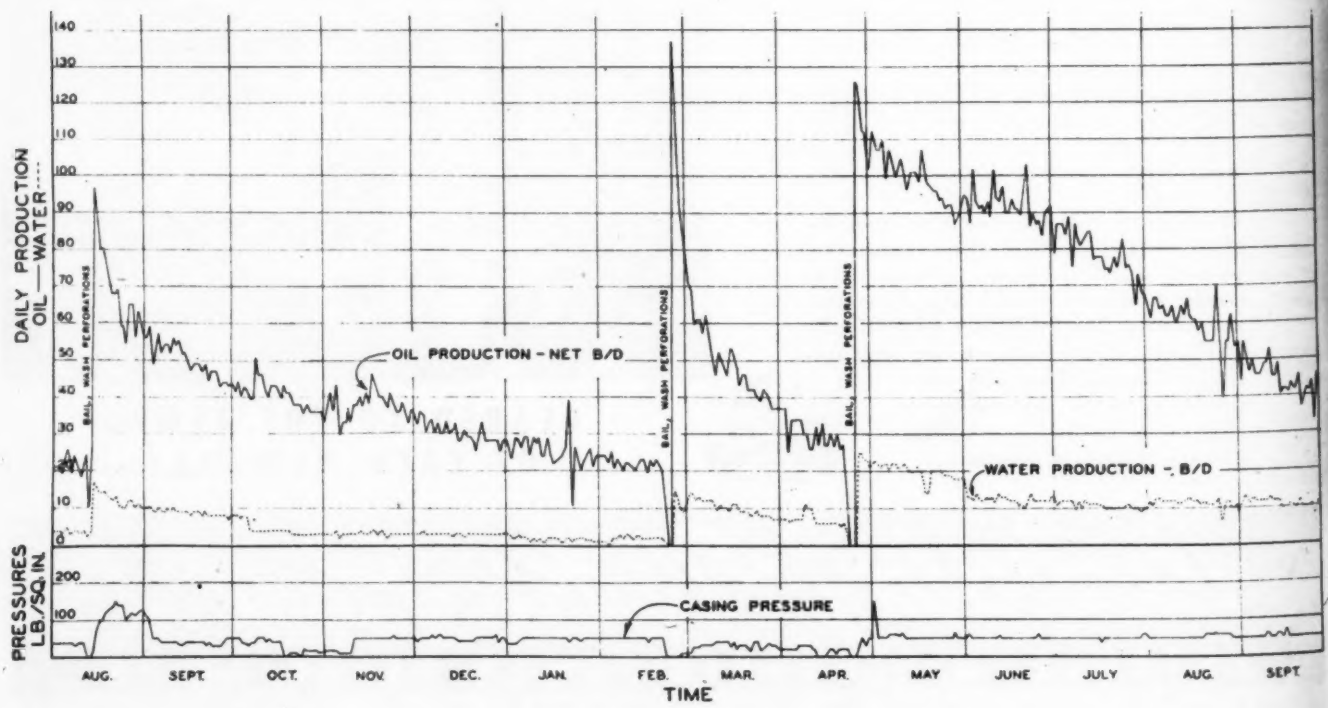
For example, a 130-bbl. well that declines 50 per cent a month should be washed after being on production approximately 37 days. If the well is washed before this time interval has elapsed or kept on production for a longer period, a greater loss of revenue is incurred.

The curves on Fig. 2 represent the difference in production between the normal field or reservoir decline, assumed to be 5 per cent a month, and the abnormal well decline, due to silting, plus the production lost during three days the well is assumed to be down for washing and the equivalent in barrels of $550, the average cost of labor and equipment rental per wash job. The omission of the latter two factors would have resulted in the optimum time interval for obtaining the maximum production from the well whereas the inclusion of these factors results in the optimum time interval for obtaining the maximum monetary returns. The normal rate of field decline,

*Presented before American Institute of Mining and Metallurgical Engineers, Los Angeles, California, October 21-22, 1943.

†Junior Engineer, Western Gulf Oil Company, Bakersfield, California, now with U. S. Navy.

Fig. 1. Production curves, well A.



deliveries, on performance
on every one of the five
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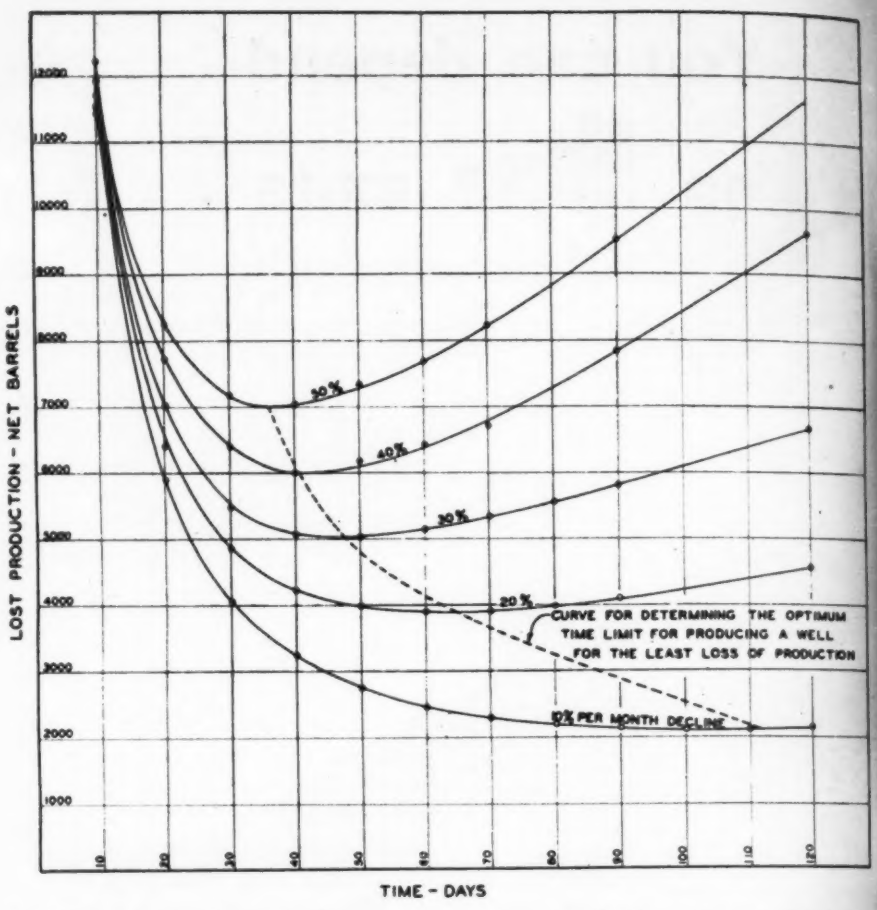
supplied from stock in
most fields.

Fig. 2.


LOST PRODUCTION - NET BARRELS
TIME - DAYS
50%
40%
30%
20%
CURVE FOR DETERMINING THE OPTIMUM TIME LIMIT FOR PRODUCING A WELL FOR THE LEAST LOSS OF PRODUCTION
5% PER MONTH DECLINE

assumed to be 5 per cent, is probably high. It is believed this factor for all practical purposes could have been omitted, because of variable well preformance and inability to stay on well pulling schedules.

Fig. 3, the master chart for determining the proper time interval for producing a well between wash jobs, regardless of size or decline, was plotted using the minimum points as determined from a series of curves, similar to those on Fig. 2, for wells of various capacities.

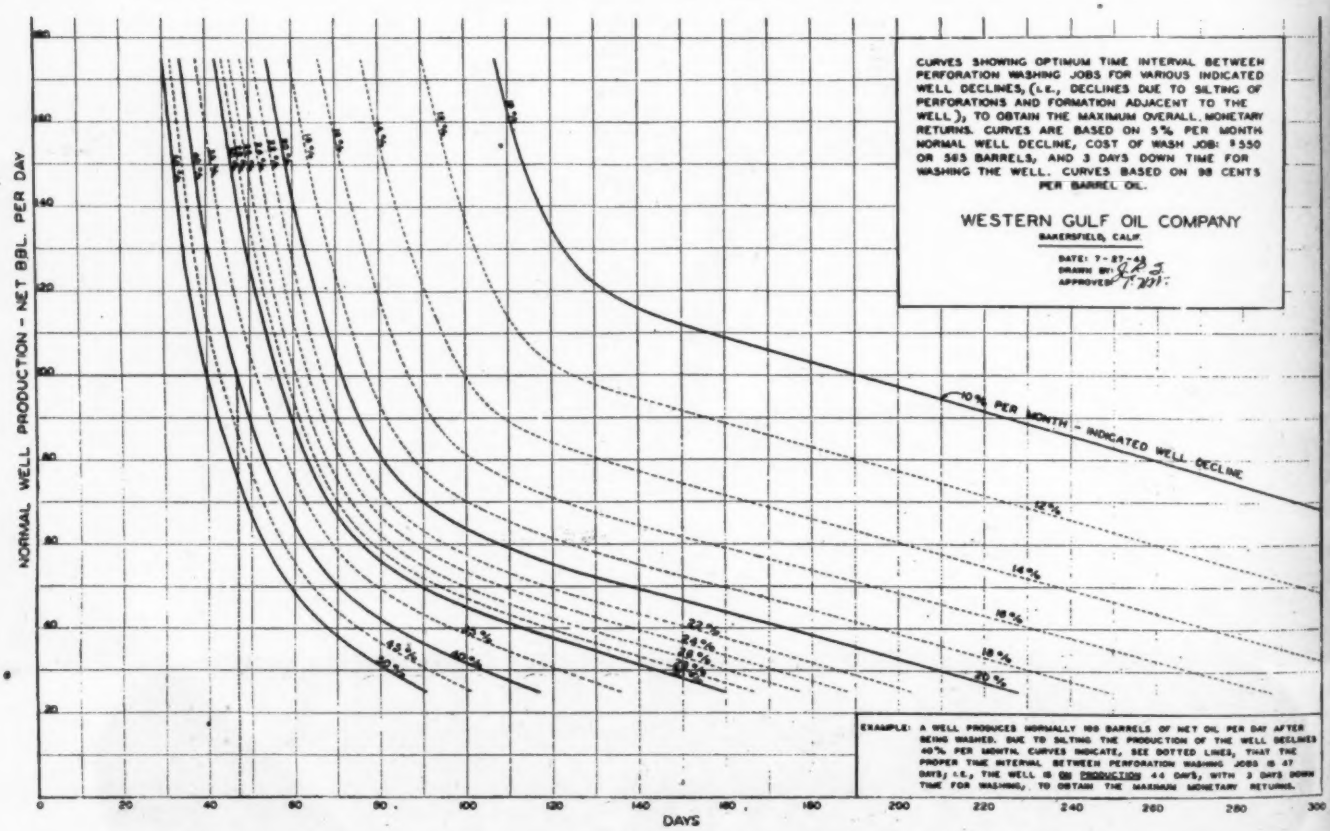
In actual operation it has not been found possible to follow the well pulling schedules required as indicated by the curves on Fig. 3, even with increased field personnel and additional well servicing equipment. As a consequence the wells are now being scheduled in order of importance; that is, the wells having high productive capacities are serviced in preference to servicing small wells. Also, certain key wells are being tested to see if reduced initial production rates will not result in the same overall production, by decreasing the apparent well decline, resulting in fewer servicing jobs.

It will be noted the curves, as plotted in Fig. 3, may be applied to any field having conditions similar to those upon which the curves are based. Also, fundamentally, the curves are reasonably simple for the importance which they assume in obtaining the maximum production with the least expense.

It is not wished, by this discussion, to imply that in actual practice the curves work out a 100 per cent—there are too many variables involved for that. The importance of the curves is that fundamentally they are correct and that they serve as a basis from which to work rather than haphazardly to pull, bail, and wash wells.

EDITOR'S NOTE: Although basically the principle of plotting the curves, as described in this article, is correct, the curves themselves, for the lower rates of production, have been found to be in error and are being corrected. ★ ★ ★

Fig. 3


CURVES SHOWING OPTIMUM TIME INTERVAL BETWEEN PERFORATION WASHING JOBS FOR VARIOUS INDICATED WELL DECLINES, (I.E., DECLINES DUE TO SILTING OF PERFORATIONS AND FORMATION ADJACENT TO THE WELL), TO OBTAIN THE MAXIMUM OVERALL MONETARY RETURNS. CURVES ARE BASED ON 5% PER MONTH NORMAL WELL DECLINE, COST OF WASH JOB: $550 OR 385 BARRELS, AND 3 DAYS DOWN TIME FOR WASHING THE WELL. CURVES BASED ON 98 CENTS PER BARREL OIL.
WESTERN GULF OIL COMPANY
BAKERSFIELD, CALIF.
DATE: 7-27-44
DRAWN BY:
APPROVED:
NORMAL WELL PRODUCTION - NET BBL. PER DAY
DAYS
10% PER MONTH - INDICATED WELL DECLINE
52%
14%
18%
22%
24%
26%
28%
30%
40%
52.5%
EXAMPLE: A WELL PRODUCES NORMALLY 100 BARRELS OF NET OIL PER DAY AFTER BEING WASHED. DUE TO SILTING THE PRODUCTION OF THE WELL DECLINES 40% PER MONTH. CURVES INDICATE, SEE DOTTED LINES, THAT THE PROPER TIME INTERVAL BETWEEN PERFORATION WASHING JOBS IS 47 DAYS; I.E., THE WELL IS ON PRODUCTION 44 DAYS, WITH 3 DAYS DOWN TIME FOR WASHING, TO OBTAIN THE MAXIMUM MONETARY RETURNS.

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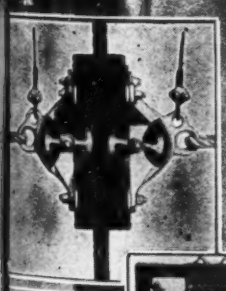

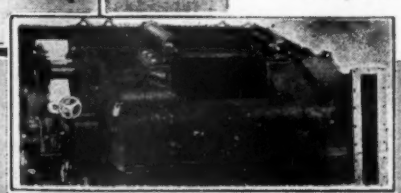

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PHILLIPS PETROLEUM COMPANY EXPERIENCE IN USE OF PEARSON ELECTRONIC COATING INSPECTOR*

By L. A. HUGO, *Phillips Petroleum Company*

THE use of holiday detectors for locating flaws in coating on pipe lines before lowering in the ground has become common practice with most pipe-line companies. The several types of holiday detectors in general use employ basically the same operating principles, i.e., high voltage leakage through flaws in the coating. These instruments are effective for the application for which they were designed; however, they do not give a measure of the coating condition after the laying and backfilling operations are complete and it is this final condition of the coating, after the line has been placed in service, that determines its effectiveness against corrosion. No pipeline coating has yet been devised that is not susceptible to injury in handling during the laying and backfilling operations. Some type of instrument is therefore required in addition to the conventional holiday detector that will locate pipe-line coating imperfections after all pipe laying operations are completed.

In an article entitled "Electrical Examination of Coatings on Buried Pipe Lines" by Dr. J. M. Pearson dated January 31, 1941,[1] details were given for test equipment and procedure for locating holes in coating on buried pipe lines.

It is the purpose of this paper to present some of the results obtained in testing approximately 150 miles of asphaltmastic coating and 45 miles of coal tar enamel with bonded wrap of 15-lb. asbestos felt with an instrument[2] such as described by Dr. Pearson. It is not the intention of this report to compare the relative merits of different types of coatings but rather to report on the use and results of the application of Pearson's device.

*Presented before National Association of Corrosion Engineers, Houston, Texas, April, 1944.

▼ **Construction details and field procedure.** An instrument was constructed by Phillips Petroleum Company, with the permission of Dr. Pearson, in accordance with circuit design as given in the abovementioned article. The instrument as constructed varied only in design of the case, an all metal case being used with a detachable battery compartment and the indicating meter and controls mounted on top.

In the operation of the instrument it is necessary to provide a source of 1000 cycle a-c. supply. This was supplied with a microphone hummer and dry cell batteries. One terminal of this 1000-cycle supply is connected to the pipe line, the other terminal to a ground rod placed approximately 100 ft. from the pipe line. The ground rod need not have a low resistance as the dry cell batteries are connected through a selector switch in order that the necessary voltage may be applied to overcome the resistance of the ground rod. The 1000-cycle current flowing between the pipe and the ground rod will carry along the pipe and through the ground, being concentrated at points of low resistance in the coating and producing voltage peaks in ground above these locations.

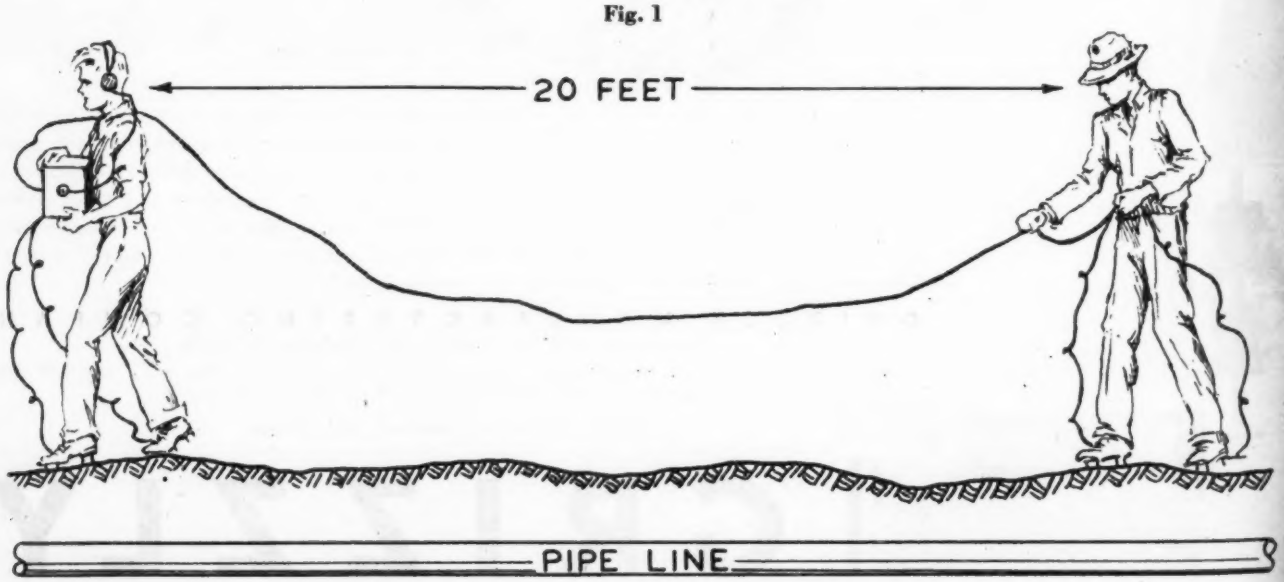
The actual locations of these voltage peaks along the line are found by two men, one of whom carries the amplifier and indicating meter, the other providing a reference ground connection. Each man has steel cleats attached to his shoes. The cleats of the first man are connected by metallic circuit to the amplifier shielding; the second man's cleats are connected to the amplifier input, (Fig. 1). Man "A" carrying the meter proceeds ahead in order to set the pace as he listens to the amplified output and watches the indicating meter, man "B" watches "A" so that he may stop without jerking the input wire if "A" detects some changes in signal and desires to recheck a small section or mark the location of a fault in the coating.

▼ **Results of asphaltmastic coating examination.** Approximately 150 miles of asphaltmastic coated 8 in. products line has been checked with the Pearson electronic inspector. All but 11 miles consists of loop lines paralleling an older line; these loops have been in service since early 1942. The 11-mile section has been in operation since 1939. A total of 80 locations were found over the 150 miles surveyed where positive signals were obtained with the instrument. Of these 80 points 11 inspection holes were dug while the instrument crew was in the field to make preliminary examination of the coating condition. At 5 of the bell holes, actual injuries to the coating were found. At the remaining 6 points where the line was uncovered no defects were found that could be detected by visual examination.

Description of conditions found at the 5 points where the coating had been injured follows:

At the first location, inspection re-

Fig. 1



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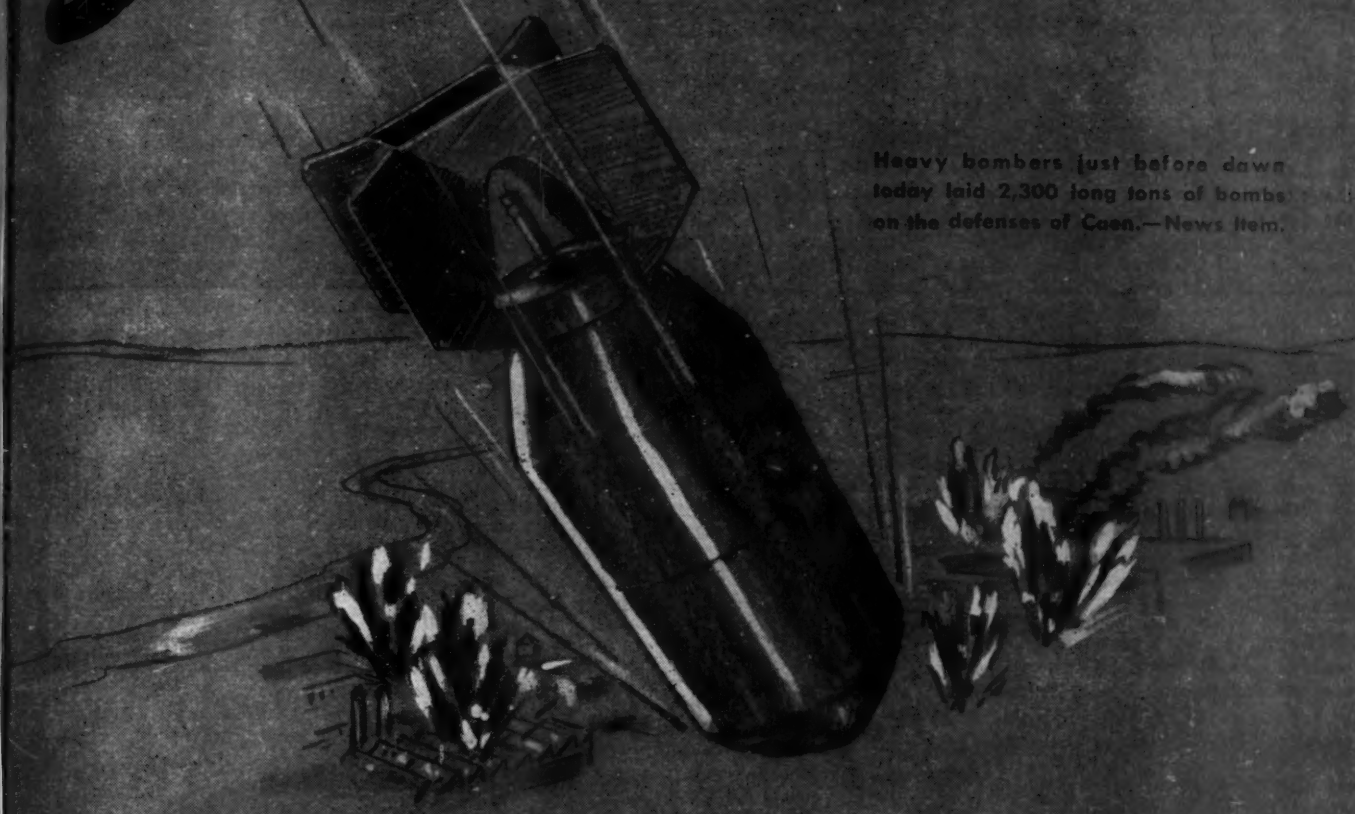

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vealed a bare spot near a field joint approximately 2 in. square. No evidence that corrosion had taken place on the bare pipe was observed. This location was along the 11-mile section of single line that had been in service approximately 3 2/3 years.

On the loop lines 2 locations were uncovered opposite the older parallel line that had been leaking gasoline. The gasoline had saturated the ground in the immediate area and caused damage to the coating.

At the fourth point an old exhaust manifold with a flange on one end was uncovered, which had evidently fallen in the ditch ahead of the backfill. The flange had hit the pipe with such force that the coating was knocked off leaving the flange resting on the bare pipe.

At the fifth point of inspection, in a rocky section of the line, indentations were found in the top of the coating where a large rock had apparently accidentally fallen on the coated pipe during backfilling operations. These indentations did not extend all the way through the coating.

Definite plans have been made to continue the inspection work at all locations indicated by the instrument, however this work has been deferred until later in the year, pending more favorable weather conditions and availability of the regular pipe-line maintenance crew.

▼ **Results of survey on coal tar enamel coated lines.** Over a total of 45 miles of coal tar enamel coated pipe, 36 locations were marked where a definite signal was registered by the Pearson detector. The line was actually uncovered and inspected at 3 of these points by the survey party; the remainder were left for uncovering inspection by the regular pipe-line maintenance crew.

At the first inspection point the coating appeared to be in good condition but on removing the asbestos felt wrapper a large holiday was found. This defect should have been found by the high tension holiday detector before the pipe had been lowered in the ditch.

At the second location the inspection revealed that a defective bevel had been trimmed from the end of a joint and dropped into the ditch and the coated pipe line lowered onto the sharp edge of the ring that had been trimmed from the pipe, fracturing the coating at the point of contact.

The third location was found to be a defective patch. The outer layer of felt was removed and water was found between the pipe and the coating, which appeared to have small pinholes. The coating at this location had evidently withstood the holiday detector test before the line was lowered due to the extra thickness of coating and felt.

▼ **Conclusions.** It is to be noted that some locations were uncovered where no defects in coating were found that could be identified as such by visual inspection. It is possible that imperfections of some type exist in these areas. At future inspection points arrangements will be made for coating conductance tests and use of conventional type holiday detector to determine whether the electronic inspector will give a response at locations where no fault in the coating exists.

Although actual inspection of the coating has been made at only 12 per cent of the total number of locations indicated by the Pearson instrument our experience to date convinces us that it is well worthwhile to make use of this equipment in testing buried coated pipe lines. It is evident that this instrument will not replace the conventional type holiday detector because the proper time to locate and repair the pinholes is while the pipe is still on the skids. The fact that conventional holiday detectors are universally used on the coating before the pipe is placed in the ground is proof that a coating of near perfection is desired, therefore, the faults caused by handling the pipe during lowering in and backfilling should be located and repaired to maintain this high degree of perfection. As there must be a flow of 1000-cycle current between the pipe and the soil through the imperfections of the coating, it is obvious that best results cannot be obtained until sufficient time has elapsed to permit the backfill to settle and soil water to penetrate the flaws or fractures in the coating. This condition should exist from 3 to 6 months after date the line is put in service.

The cost per mile for a survey with the Pearson electronic inspector will vary widely depending upon conditions encountered. If the route of the pipe line can be determined without the use of pipe-line locators it is possible for 2 men to cover 4 to 6 miles per day and mark or record the locations of faults for later inspection.

It is hardly necessary to point out the advantages and monitary savings that will accrue to the pipe-line industry generally upon perfection of the operation and interpretation of the results of the Pearson instrument. When it becomes possible from surface survey to gauge the condition of buried pipe coating, reconditioning may be accomplished with minimum expenditure of money and manpower. Instead of uncovering an entire line for inspection and repair, only those scattered points established by coating survey need be uncovered. As it frequently costs fully as much to recondition a pipe line as the line cost new the possibilities of reduction in reconditioning costs can be fully appreciated. Furthermore, good coatings are often damaged during uncovering for inspection, which constitutes a waste that good detection apparatus will eliminate.

On spot coated lines the ends of the coated sections may be readily established on the surface of the ground without exploratory excavation.

External corrosive action on coated lines may be virtually nipped in the bud by timely coating repairs at the locations indicated by surface survey.

The instrument may be adapted to other uses than locating faults in coating; it is an excellent pipe-line locator when fitted with a loop antenna, and may be used without a transmitter in the vicinity of cathodic units. Should there be a suspicion that a tap existed on a coated line it could easily be determined whether the coating had been disturbed. Similarly, if a leak should occur even though it be only a very small seep and does not appear on the surface of the ground it would cause a hole or fault in the coating that could be detected.

For the reasons pointed out, more general study and use of instruments of the type described should be encouraged by all concerned with underground lines. The results will no doubt lead to:

1. Improved types of underground pipe-line coatings.
2. Improved coating application and pipe laying techniques.
3. Improvement in detecting coating flaws before the line is lowered in the ditch and backfilled.
4. More intelligent and effective reconditioning practices at a substantially lowered cost.

▼ **Acknowledgments.** The writer wishes to acknowledge the work of Dr. J. M. Pearson of the Sun-Susquehanna Pipe Line System who developed the instrument and method of application described, and express his appreciation for permission granted to construct, operate and conduct further studies along the lines initiated by Dr. Pearson.

The cooperation of the Nelson Electric Manufacturing Company and H. A. Norberg in the construction of the equipment used by Phillips is gratefully acknowledged.

The efforts of employees of the products pipe line and engineering departments of Phillips Petroleum Company whose cooperation in conducting surveys and preparing data for this work are fully appreciated.

References

1. "Electrical Examination of Coatings on Buried Pipe Lines," by J. M. Pearson, *The Petroleum Engineer*, July, 1941.
2. Manufactured by Nelson Electric Manufacturing Company under supervision of H. A. Norberg.

★ ★ ★

New oil company formed

The American Eastern Petroleum Company, formed by The Texas Company and Standard Oil Company of California, will direct exploration and development of properties in Egypt, New Zealand, Australia, and the Netherlands East Indies when they are freed from Japanese control.

The new company will not control operations in Arabia and Bahrein Island, which are already under the management of Bahrein Petroleum Company and California-Arabian Company, also owned jointly by The Texas Company and California Standard.

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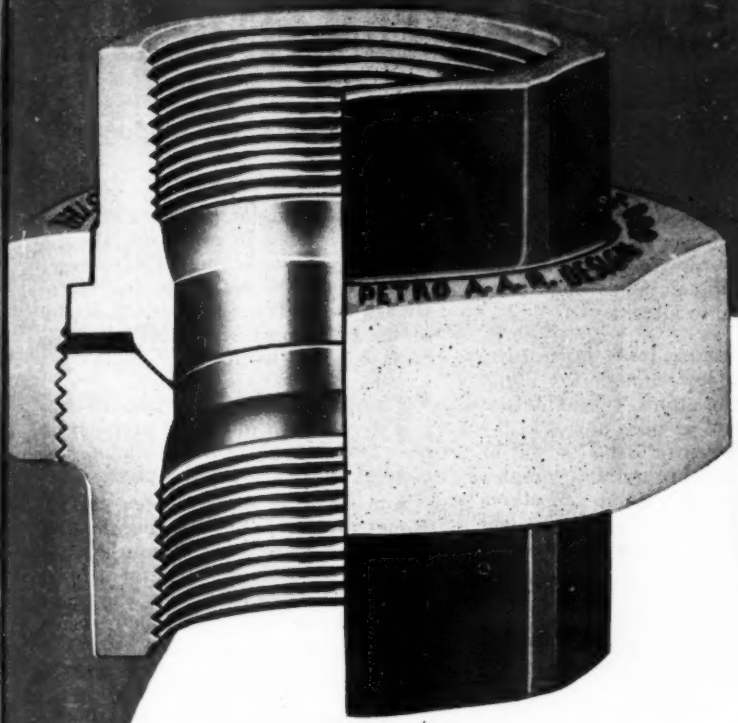

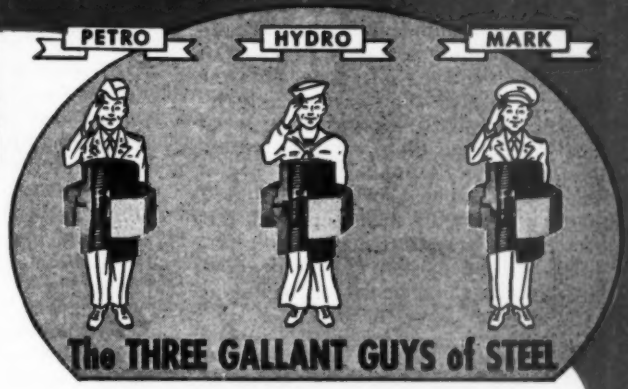

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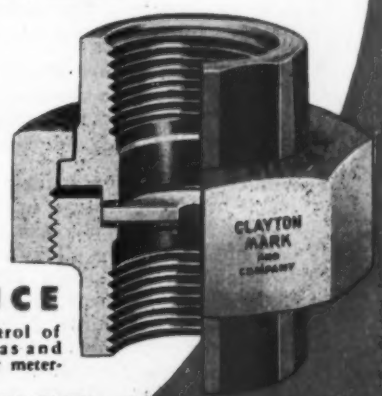

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SERVING THE OIL AND GAS INDUSTRIES

APPLICATIONS OF NICKEL CONTAINING CORROSION RESISTANT ALLOYS IN THE PETROLEUM INDUSTRY*

By B. B. MORTON, *The International Nickel Company, Inc.*

CORROSION has always presented difficult problems in the petroleum industry. The production and refining divisions of this industry are particularly subject to corrosion of equipment. With recent advances in refining technique a number of reagents have been introduced into the refining division that have greatly increased the corrosiveness of the material handled. Among these reagents are hydrofluoric acid, sulphuric acid, hydrochloric acid, phosphoric acid, and a number of solvents such as phenol, furfural, etc. Regeneration of caustic has also raised the question of suitable tubes for the boiler and material for the linings of equipment.

▼ **Refining division.** The equipment used in refineries is probably the most viciously assailed by the greatest variety of corrosives of any equipment in the entire industry. Refinery corrosion is sharply controlled by temperature with respect to character and intensity. In general the character of attack changes with the presence or absence of liquid water and this permits setting a range line of change in attack at about 500°F. Above this temperature the attack is usually directly upon the metal and results often in forming a scale that is a metallic compound. Below the temperature of about 500°F. the attack is usually of the electrolytic type and is governed by factors influencing this type of corrosion, as for instance, differences in potential, overvoltage, oxygen, etc.

▼ **Elevated temperature attack.** At elevated temperatures the two chief sources of attack at the present time are sulphur and naphthenic acids.

▼ **Sulphur.** To protect against sulphur attack at high temperature, in excess of 500°F., there must be increasing quantities of chromium in the alloy; 12-14 per cent chromium steel, also 18-8 strip welded with 18 per cent chrome-8 per cent nickel, or preferably, 25 per cent chrome-20 per cent nickel rods are widely used to line reaction vessels. Tubes of 18-8 are used and this alloy is also extensively used as a valve trim and parts.

▼ **Naphthenic acid.** Where the attack is from naphthenic acids at elevated temperatures 800°F. and above, the 18 per cent chrome-8 per cent nickel alloys with 3 per cent molybdenum (type 316) or Inconel† (approximately 80 per cent nickel, 13 per cent chromium) are apparently the most resistant of commercial available alloys; 18-8 carbon steel and many other alloys are rapidly destroyed by naphthenic acids under conditions favorable to attack.

▼ **Electrolytic attack, low temperature.** At temperature low enough for liquid water to exist the attack is usually best resisted by Monel or pure nickel in the case of weak concentrations of acids; or by the special nickel containing complex alloys, as the Hastelloy group and others as Illium, Pioneer Metal, Worthite, and the LaBour groups at high concentrations.

▼ **Hydrochloric acid.** Weak concentrations of hydrochloric acid are generated in cracking equipment from salts contained in the crudes. Monel is used as caps and trays, also as lining material for towers, condensers, and other vessels where the metal temperature will not exceed 500°F. In the case of isomerization using an atmosphere of HCL, the Hastelloy B* appears by test to offer the highest order of resistance. Nickel is also being tried and is under present observation in an important installation. A judicious use of Hastelloy B and nickel or Monel is suggested in connection with isomerization units.

▼ **Sulphuric acid.** The alkylation of petroleum fractions is important in the 100-octane program—sulphuric acid in concentrated form is used as a catalyst. Hastelloy D, a cast alloy of nickel and silicon is most resistant of high strength alloys to resist all concentrations of sulphuric acid. The cast nature and low ductility of this alloy somewhat limit its use.

Hastelloy B is very resistant to pure sulphuric acid and satisfactorily so to acid contaminated by the usual material encountered in refineries. This alloy is especially useful where a wrought material is required. It is applied as parts of pump, valves, and fittings.

The corrosion rate of Hastelloy B increases rapidly if copper is a contaminant of the sulphuric acid.

LaBour R-55 and Worthite are also used, especially in pump parts to handle high concentration of sulphuric acid. Valve parts of these alloys are reported to give satisfactory service in contact with sulphuric acid.

▼ **Hydrofluoric acid.** Hydrofluoric acid is used to catalyse the alkylation reaction in the formation of high octane material.

Monel is quite resistant to hydrofluoric acid under the conditions in which it is used in refineries. Monel is probably the most useful of commercially available materials for contact with this acid. It is applicable to all parts of the equipment of the HF alkylation units as now constituted.

▼ **Phosphoric acid.** The type 316 stainless steel, 18-8-3 Monel, is probably the most resistant of readily available, commercial alloys against phosphoric acid.

A widespread use has been noted of Monel to line headers, manifolds, and valves subject to a weak, aqueous solution of phosphoric acid generated during steaming the catalyst bed. The Monel takes on a cooper tinge in some instances and then corrosion occurs at a very slow rate.

▼ **Solvents.** The chlorinated solvents often break down to form a corrosive reagent. Monel is highly resistant to this reagent and also tends to prevent the breakdown. Monel is widely used to contact carbon tetrachloride in various industries.

Phenolic compounds, especially when contaminated with sulphur, rapidly attack carbon steel. The 18-8 stainless is used as liners and tubes to contact phenolic compounds and hydrocarbons at elevated (above 500°F.) temperatures. Monel is highly resistant to the phenol group of solvents and to furfural, which is also extensively used in petroleum refining. Vessels clad with Monel, and in one case sprayed with Monel, are used to store furfural.

▼ **Caustic regeneration.** Caustic regeneration has become of increasing importance in refineries. The tubes of the boiler suffer severe attack when made of steel; also some parts of the vessel walls are attacked.

Monel tubes have made an excellent showing when used in the tubular boilers. Monel clad steel or local cladding can be applied to walls of the vessels when attacked. Monel clad steel is indicated for tube sheets of the reboilers.

▼ **General refinery corrosion.** For general refinery corrosion, such as experienced in handling reflux and treating of light fractions, and in handling corrosive waters, the alloyed cast-iron Ni-Resist† is most useful. It will be found applicable as pump parts, such as liners, pistons, valve parts, also as impellers and casings. K-Monel is suggested as the pump rods and shafts. Monel valves have

*Presented before National Association of Corrosion Engineers, Houston, Texas, April, 1944.

†Registered trade name.

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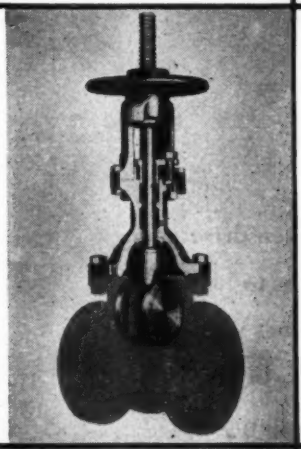

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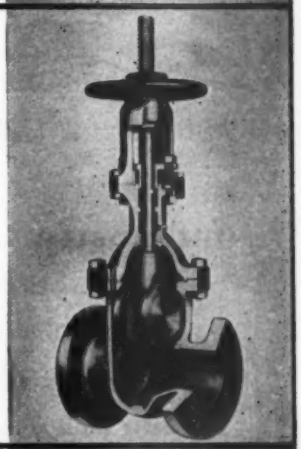

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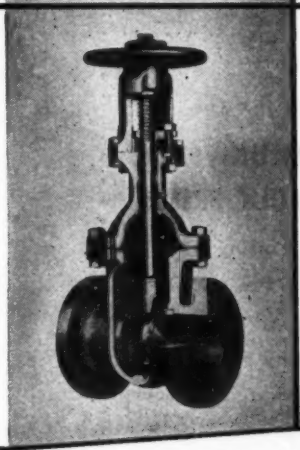

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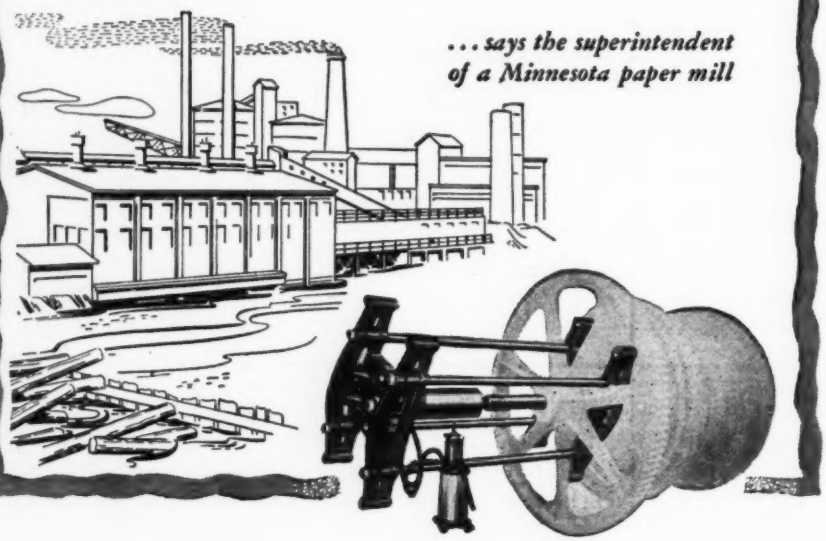

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done excellent service in pumps handling corrosive stocks at temperatures below 500°F.

▼ **Production division.** The production division has many problems peculiar to the drilling for petroleum and subsequent raising it to the surface.

Corrosion fatigue of drill pipe has been noted in many quarters. An effort to offset this difficulty was put forth, prior to the war, by a prominent western oil company by using an alloyed drill pipe. A composition of alloy by the trade name Yoloy was employed. This alloy steel contained approximately 2 per cent nickel, 1 per cent copper. Its mechanical properties exceeded those specified for Grade D drill pipe. The performance of the Yoloy pipe was reported as excellent and apparently more than justified expectations from a standpoint of resisting corrosion fatigue, abrasion, and the complicated forces acting upon a drill pipe.

Abrasion is always a problem associated with production. Nickel containing alloys, such as the colomonoy group with nickel bases, and the well known lining materials containing nickel and boron find application in connection with mud handling.

The various types of Monel are used in connection with pumping. Monel polished rods have established a good reputation in West Texas and West Kansas. K-Monel balls or drops and seats are excellent for shallow corrosive wells.

A string of K-Monel sucker rods in service in West Texas, after about 3 years' service, are in excellent condition. SAE 4620 rods gave a life of 6-8 months in the same well. The continued corrosiveness of the well is attested by vigorous attack upon steel parts of the pump. These parts are being replaced by Monel.

Monel has long been the material used in gas lift equipment. The bodies are often of regular Monel and the valve of K-Monel (a hardenable form of Monel).

Ni-Resist cast-iron has demonstrated a high order of resistance to the salt water associated with petroleum production. It has long been used in pumps handling brine and contaminated salt water. The use involves liners, pistons, impellers, and valve parts. Monel shafts, rods, and valve parts are used as a result of the well established resistance of Monel to salt waters. ★★★

Phillips in Canada

The Phillips Petroleum Company is scheduled to have begun a wildcat oil test in its recently acquired 30,000 acres in Alberta, Canada, after a year of geological exploration. The test will be in section 22-18-5W5th, on the Sullivan Creek anticline in the south Alberta foothills. Phillips has built a road to the site of the unsurveyed territory and has set up drilling rig.

This is Phillips' first venture into Canada. The company, one of the largest independent operators in the United States, has been active recently in South America.

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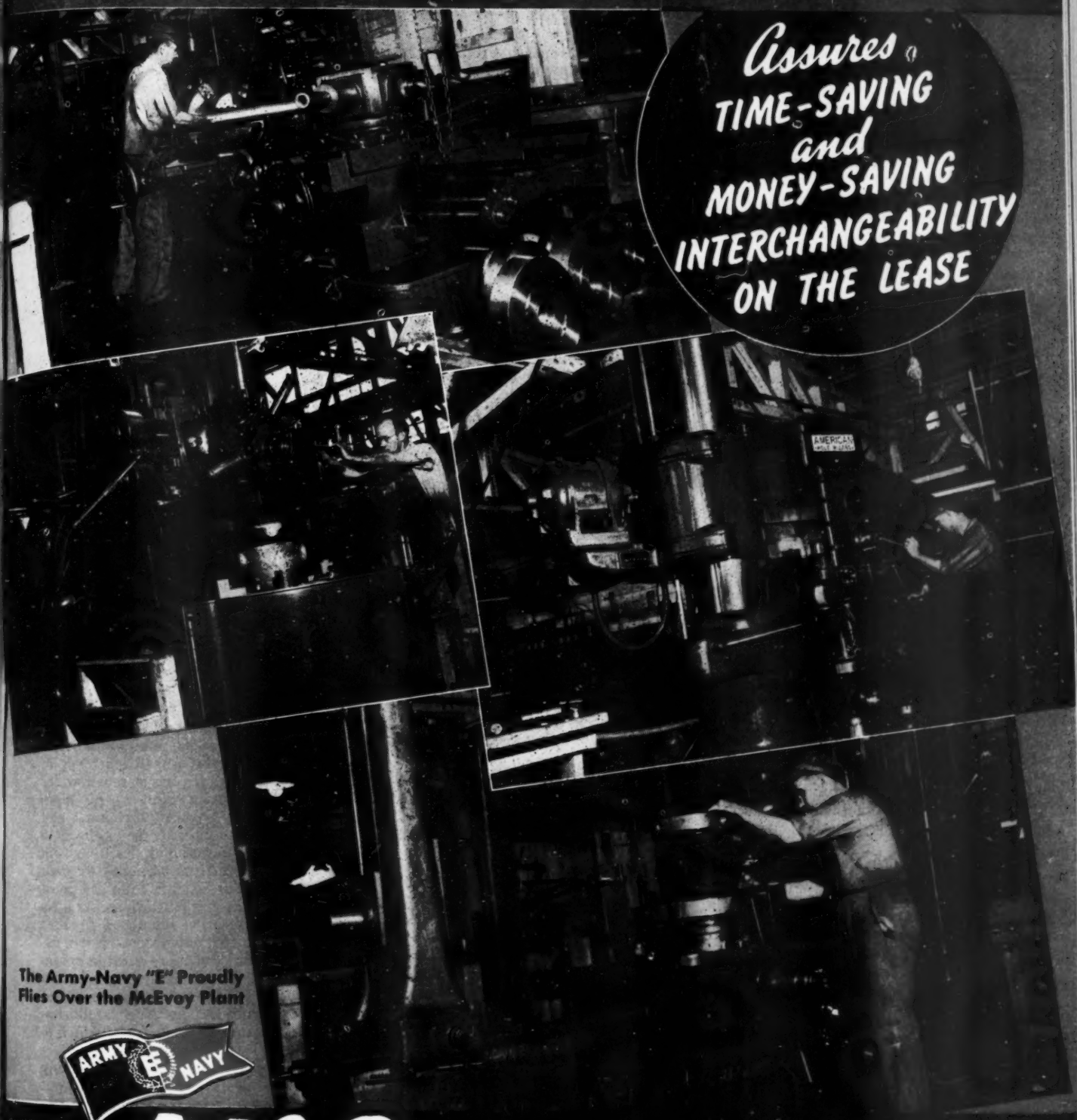

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TEXAS AT MILBY

THE NEED OF THE DRILLING CONTRACTOR in the Oil Industry*

By CHASE SUTTON, *Pure Oil Company*

THE subject title of these remarks was assigned the speaker by, as far as I know, the program committee. It was not until after giving considerable thought to the subject that I fully appreciated the careful wording used.

I would call attention to the phrase, "in the oil industry."

It certainly is my opinion that the drilling contractor is and should remain *in* the industry and not because of any local condition or anticipated currently favorable regulations become a separate entity. The objectives of the operator and the contractor are too closely allied and too dependent upon mutual success that any distinct separation establishing the drilling contractor as an independent unit could only bring ultimate dissatisfaction to one or the other group. As has happened in other similar situations, one development of such a condition would be the establishment of drilling concerns by the operators which concerns would have numerous advantages in relation to the independent contractor. The difficulties of the independent would, under such competition, be greatly multiplied.

Further, it appears to me that the drilling contractor who, in a non-competitive manner, acquires and operates some producing properties, has as a rule established himself as a more reliable, substantial, and cooperative unit than those organizations that have not done so.

It gives the contractor, especially during these times, a better understanding of the operator's problems and difficulties, and above all it permits the contractor during periods of decline in drilling operations an operation around which he can continue to maintain his organization at least so far as essential personnel is concerned.

In exploring the many phases of the subject, I find that in the final analysis they can briefly be summed up into a single statement and no doubt this meeting, as well as my own reputation, would be much better off if I would make such statement and sit down.

Having been requested to take up a certain amount of your time, I will not only make the summarized statement, but like the normal contractor's invoice repeat the dose by the foot, by the day, by the hour, and on a rental basis. This should make certain that even though as with your invoices you only get paid on one basis you probably will be getting fair value.

To me the summation of why the contractor is needed in the oil industry is that through his services he provides for the industry the most economical and effective utilization and efficient use of manpower, material, and supplies in the drilling operation.

The extremely wide range of conditions under which contractors are required to perform their services and the equally wide variations in organization and equipment of contract drilling organizations make necessary for the purpose of this discussion a few limiting definitions that we will presume to be applicable to these remarks.

The term "drilling contractors," as used in this paper, is defined and refers to an individual or organization who is qualified through experience, organization, and financial credit, and possesses or can obtain the most suitable equipment to perform the specific job.

We can, therefore, by applying this definition eliminate from these remarks those drilling contractors who, for local or personal reasons, accept obligations that are either beyond their limitations or that are not rightfully in an operational contract class.

The contractor "provides the most economical and efficient use of manpower, material, and supplies."

It would also seem desirable partially to define an operator as an individual or company who has or can obtain experienced operational personnel and who is in position to liquidate his or its obligations as they accrue.

Taking the broad view of the drilling contractor, we will further assume that the contract when formally executed is based on mutual good faith; that the operator has a job to be done and that the drilling contractor is fully qualified to perform the job.

A contract executed and fulfilled under such conditions seldom results in other than satisfactory relationship and mutual benefit.

MUCH has been written and much more has been said regarding what constitutes the basic job of the drilling contractor.

After wandering through a maze of inclusions and exclusions, free "this's" and free "that's", which are found in many contracts, my opinion is that, narrowed down, the basic job of the drilling contractor is to dig a hole in the ground. Such a job to any but a well driller is simply a matter of moving dirt. True, in well drilling operations the dirt to be moved is not visible and may range from the so-called snowbank to various types of hard rock.

Fortunately the extremes of variation in drilling formations seem to average out so that in any localized area a reasonable penetration rate can be established.

It seems to me that if the average or normal drilling contract were based on the above assumptions and that all additional supplemental operations were a matter of supplemental agreements and were compensated for in relation to the cost thereof, a much more equitable and satisfactory relationship would exist as between drilling contractors and operators and the strained relationships so frequently developed would for all practical purposes be eliminated.

AFTER these rather lengthy preliminary remarks, it would seem desirable to amplify the simple statement made earlier—that the drilling contractor is needed in the oil industry because he provides the industry with the most economical and effective utilization and efficient use of manpower, material, and supplies.

I believe the full realization of the drilling contractor's place in industry has become more apparent during the war period than ever before. This is particularly true in manpower utilization. By performing drilling service for a multiplicity of operators he is in a much better position to maintain steady employment of experienced personnel than is the individual operator. This not only results in a more effective operation but has many complimentary benefits, such as, reduced accident rates, better care and maintenance of equipment, continuation of the improvement of operating technique, etc.

From the experience standpoint the drilling contractor has many opportunities to improve the overall efficiency of his organization. He has a much wider range of operation both as to depth of drilling and types of formation and conditions encountered, as well as a multiplicity of regional locations, in some instances being national or even international in extent, than do most company drilling organizations. As a result his organization obtains a broader and more varied experience. Such experience permits of more flexible operation and a better use of manpower and equipment. If he takes advantage of these opportunities he soon establishes his performance as the mark at which to shoot.

It is not accidental that when company pushers are desirous of increased output they almost invariably give their crews the order to "start contracting."

The question of utilization of material and supplies almost parallels the manpower program. Idle tools earn the contractor no profit, consequently one of his many objectives is to keep the tools operating.

On the other hand, we frequently hear

*Presented before American Association of Oilwell Drilling Contractors, Houston, Texas, October 6, 1943.

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oilmaster TUBING LINER

A standard sectional tubing liner pump for volume conditions (Hardened cast alloy liners).

Every operator—large or small—who wants to cut lifting cost will find a ready solution in "Oilmaster" Pumps—the Pumps featuring hardened and honed barrels.

Consult our service men for complete information and help on your pump problems.

Cross sectional view of the improved insert pump barrel showing how super-hard wearing surfaces for long life are combined with ductile core for toughness.

Here's an outstanding achievement of modern metallurgy—a one-piece pump barrel which is both hard . . . and tough! While most pump barrels are either hard (and brittle) or tough (and not so hard), Oilmasters combine both these important advantages in one barrel. They have a super-hard wearing surface which measures 64-70 on the Rockwell C scale, and a tensile strength of 145,000 p.s.i.—all in the same piece of metal!

There is no need to use pumps with untreated barrels when you can get 4 to 8 times harder barrels that wear 2 to 5 times longer. Why be satisfied with untreated barrels, when Oilmaster pumps equipped with super-hard barrels, cost no more than pumps using cold drawn barrels? Get the complete story on how Oilmaster hardened and honed barrels increase pump life!

The unprecedented hardness measurements of Oilmaster hardened and honed barrels (shown in the accompanying chart) account for the outstanding performance records of Oilmaster Pumps.

	BRINELL	ROCKWELL
Oilmaster Hardened and Honed Pumps	627	64-70-C
Untreated Steel Pumps	150 to 170	6-14-C

FLUID PACKED PUMP COMPANY *Manufacturers of* **oilmaster** *Products*

MAIN PLANT: LOS NIETOS, CALIFORNIA

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Tube Borium Keeps 'em digging

DULL IN 3 DAYS
STILL SHARP AFTER 30 DAYS
STOODY TUBE BORIUM* KEEPS DITCHER TEETH SHARP ...ELIMINATES FREQUENT SHUT-DOWNS FOR TOOTH CHANGES...CUTS REPLACEMENT COSTS UP TO 75%

The two ditcher teeth pictured above were used on the same machine and operated under identical conditions.
The unprotected tooth at the top had to be sharpened every three days and was too short for further service after six sharpenings.
But the Borium-protected tooth at the bottom operated for 40 days and wore only ½". It was simply resharpened in the forge, retipped with Tube Borium, and put back on the ditcher for another 40 days' service.
Before the tooth was finally worn out, it had operated a total of 120 days!
Tube Borium makes such savings possible because the deposits represent the ultimate in wear resistance and the ability to cut hard earth formations.

*Stoody Tube Borium is supplied in rods of ⅛", 5/32", ¼" and ⅜" diameters and is available for either oxyacetylene or D.C. electric application. Prices and specifications are yours for the asking.

These tungsten carbide particles do not melt when tube is applied but are held in suspension in a mild steel matrix forming a deposit resembling coarse sandpaper.

Send for free booklet on TUBE BORIUM, showing sizes and styles of rods and recommended methods of application.

STOODY COMPANY
1142 West Slauson Ave., Whittier, Calif.

STOODY HARD-FACING ALLOYS
Stop wear... Eliminate Repair

almost the exact opposite from company drilling organizations: That shutdown rigs are saving money—economically, all know this to be unsound. Any time a quarter million dollar rig is standing idle its services are lost—absenteeism from the production line or in the form of an idle unit is wasteful.

A further advantage of the drilling contractor is his ability to, in most cases, equip the specific job with a unit reasonably suitable for the job. This I believe a most desirable condition although a difficult one to fully evaluate.

All too frequently the only company rig available is actually too large or too small but is nevertheless used because of its availability. Contractors can, no doubt, improve their overall efficiency by more generally cooperating between themselves on a lease-lend basis to better accomplish this objective.

Much has been accomplished in recent months, some of it voluntary and some of it not so voluntary, in transportation phases. Contractors possess a most favorable opportunity to promote further the reduction of transportation required by cooperative utilization of rigs and other equipment.

The ofttimes unnecessary hauling and moving of material, equipment, and supplies from state to state and back to state again is little advanced from the Pongo bird that jumps from precipice to precipice.

By taking advantage of the above-named favorable opportunities, the contractor will find that his services are sought after by a considerable clientele. Having established himself, currently, as a reliable and efficient contractor, he then incurs another obligation, that is, to maintain his personnel and equipment in a modern and up-to-date manner. He must be progressive and keep his organization on its toes, not only in utilizing improved practices but in replacing obsolete and unsafe equipment.

Numerous additional, and in some cases equally important items, could be cited conserving the need for and opportunities of the drilling contractor further to establish his importance to the industry. The matters mentioned are, however, sufficient to establish a sound basis for further discussion.

You will note that so far I have entirely avoided the oft-stated objection to contract drilling and drillers, which is generally to the effect that the contractor is interested only in the footage made and cares little of the outcome of the job, so long as the contract results in a sure profit at least equal to expectations. Such a short-sighted policy is, thank goodness, being rapidly eliminated—mostly by self-elimination.

One contract (a well contract) very seldom makes a contractor rich and a repetition of ineffective and unintelligent drilling operations soon creates a spirit of distrust toward any drilling organization that very quickly reduces or eliminates the submittal of further proposals.

The truly progressive and sought after drilling contractor is the one who, upon accepting a contract, places the interests of the operator on the same plane of importance as his own interests and who develops an organization that not only effectively performs the specific terms of the contract but as equally effectively conducts the operation to the satisfaction of the operator.

It is certainly true that drilling contractor organizations have in the past developed and contributed much to the art and technique of drilling operations. Most of these contributions have been brought about either by accident or economic necessity or desirability rather than research.

It appears to me that this association could well afford to create a research division, the efforts of which would be directly applied to the various phases of contract drilling, operational, managerial, technical and otherwise. You have within your member ranks some of the most capable and best informed personnel in the industry who no doubt would be happy to direct such an effort. Further, I am certain the research division of both operating company and manufacturer would be more than willing to cooperate. The relationship of contractor and operator must always, to be mutually satisfactory, be on the basis of repetitive contracts.

This necessitates above all a good faith understanding and operating agreement. If both parties have such a relationship the hazards and uncertainties of certain operations usually settle themselves on the basis of mutual agreement and understanding.

It seems to me the *need* for the drilling contractor in the operational end of the oil business is definitely established. The extent to which the contractor can make this *need* an *essential need* lies wholly within the contractor's hands. The opportunities for doing so are better now than ever before, and if contractors realize and appreciate these opportunities and proceed accordingly they should have little difficulty in establishing their essentiality.

Reduce spacing units for salt dome fields

Salt dome fields or fields of similar characteristics may now be drilled one to each 10 acres, according to an order announced by the Petroleum Administration for War. The size of drilling units formerly allowed in these 79 fields in Texas and Louisiana coastal regions was 40 acres.

The order, which is supplement No. 13 to Order No. 11, lists the specific fields in which the drilling unit is reduced. The reworking, deepening, and recompletion of old wells in another pool in the specified fields may be carried out also on a 10-acre spacing basis. The order does not suspend applicable state regulations respecting the distance of wells from property lines; it eliminates applications to drill on less than 40-acre units.

On Guard

10,000.00 FEET DOWN!

GUIBERSON tubing catchers are on the job 24 hours a day instantly alert to grab a section of parted tubing or to stop the tubing from dropping when an accident occurs. Quick acting compression springs retard the fall and slips, actuated by weight, drive wedges that instantly grip casing walls. Stops dropping tubing in three inches. All Guiberson tubing catchers are positive acting with large slip area. Give largest fluid and gas by-pass area. Short and compact in design with minimum moving parts. Made of steel throughout with slips precision machined alloy steel. Guiberson tubing catchers keep an unseen guard on the job to save time and money when an accident occurs.

Type "E" Tubing Catcher with Anchor

TYPE "E"

Designed for use in wells carrying up to 11,000 ft. of 2" tubing or 8,000 ft. of 2½" tubing.

TYPE "B"

Slightly smaller than Type "E" with spring not enclosed by weight. For use with up to 7,200 ft. of 2" tubing.

TYPE "F"

Designed for extremely deep wells. Duplex type catcher with twice the slip area of Type "B" catcher.

GUIBERSON TUBING ANCHORS Available for all tubing catchers. Anchor stops tubing movement in pumping. Helps increase production. Prolongs life of tubing.

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P 615.635.4

DESIGN AND CONSTRUCTION OF TAP CHANGING TRANSFORMERS FOR CATHODIC PROTECTION

By E. G. GODDARD, *Jefferson Electric Company*

▼ **General.** For cathodic plating to prevent corrosion, it is necessary to have a direct current supply of a relatively low current and voltage. This direct current may be obtained most readily by using a bridge type rectifier of the dry disk type and a transformer for reducing the line voltage to the correct voltage for the rectifier desired.

The railway signaling circuits are very similar in nature to this system, as it is necessary to produce a d-c. source for charging batteries for standby signal operation in event of line voltage failure. The transformer design for cathodic plating follows the R.R. unit in tapped voltages for the secondary or low voltage circuit. Where the lines are subject to lightning interruption, special insulation is built into the transformer windings and lightning arrestors are used.

It will be well to give attention to the railroad system of installation of transformers and rectifiers with their service record in the development of the cathodic system for the protection of tanks, pipe lines, and the like.

▼ **Transformer function.** A transformer is an electrical device for transferring energy in an alternating current system from one circuit to another. It consists essentially of two independent electric circuits linked with a common magnetic circuit. Thus energy at high voltage may be transformed to energy at low voltage or vice versa. In a like manner, current of a given value in one circuit may be transformed into current of another value in a different circuit. The winding of the transformer connected to the supply circuit is referred to as the primary winding and those windings of the transformer that are connected to the load circuits are referred to as secondary windings. If the secondary winding of a transformer is open and has its primary connected to an alternating current supply system, only a small current will flow through the primary. This current is alternating and produces an alternating magnetic flux in the iron core of the transformer which interlinks both the primary and secondary windings and by its rate of change induces an electromotive force change in each coil.

If the two windings are closely associated with each other, the electromotive force changes induced in each will be proportional to its respective number of turns. The EMF induced in the primary winding is known as the counter EMF of self induction of the primary or back EMF and is equal in magnitude to the EMF of the mains less the voltage drop due to the current passing through the winding. Therefore, if the permeability of the magnetic circuit of the transformer is high and the resistance of the primary winding is low, the counter EMF will be very nearly equal in magnitude to the EMF of the supply circuit and it further follows that the secondary induced EMF will be nearly equal to the EMF of the supply circuit, multiplied by the ratio of the number of turns in the secondary winding to that of the primary winding.

As the development of the transformer art has advanced to a high degree in the perfection of design and materials, very low losses in the transfer of electrical energy result in high efficiency in operation. Transformers have no moving parts to wear out so that if properly made and installed they should last indefinitely.

▼ **Recommended design.** Transformers designed for remote control systems using rectifiers are preferably of the two-winding type, completely isolating the commonly grounded supply system from the secondary or direct current circuit. The rectifier operates at 15 volts or less so that the circuit may be handled safely by any person who may contact live parts of the secondary circuit.

As rectifiers are subject to the possibility of either internal or external short circuits, it is desirable to have protection in the form of circuit breakers or fuses in the primary or secondary to prevent the possibility of overloading and burning out of the transformer, should such a condition occur.

It is further desirable to protect the transformer coils and insulation from moisture or acid bearing fumes that may cause insulation failure or electrolysis, resulting in opening of the winding or short circuiting, causing transformer failure. This protection can be obtained by suitable impregnation in the form of heavy varnish coatings, compound dipping, or enclosing the transformer in a corrosion resisting watertight container. In the latter case terminal connections through insulating material can pass through the container in a watertight manner.

▼ **Transformer structure now in service.** A number of transformers are now in service for cathodic plating on a pipe line, which have the following electrical specifications. They comprise core and coil type units, varnish impregnated under vacuum, and sealed with an overall coating of 250°F. melting point compound. They are of the two-winding type layer built coils filled with 29-gauge annealed electrical steel of 300 va. capacity. The primary is designed to operate on 115-volt, 60-cycle systems, or a maximum voltage of 130. The secondary winding is 15 volts tapped at 3, 6, 9, 12, 13, 14, and 15 volts, enabling one-volt steps from 1 to 15 volts.

For a better understanding of the tapping arrangement of the secondary winding, a schematic diagram is shown in Fig. 1.

For example if primary is 115 volts:

To obtain a secondary voltage of 10 volts connect to taps No. 2 and No. 6.

To obtain a secondary voltage of 12 volts connect to taps No. 1 and No. 5.

To obtain a secondary voltage of 13 volts connect to taps No. 1 and No. 6.

To obtain a secondary voltage of 14 volts connect to taps No. 1 and No. 7.

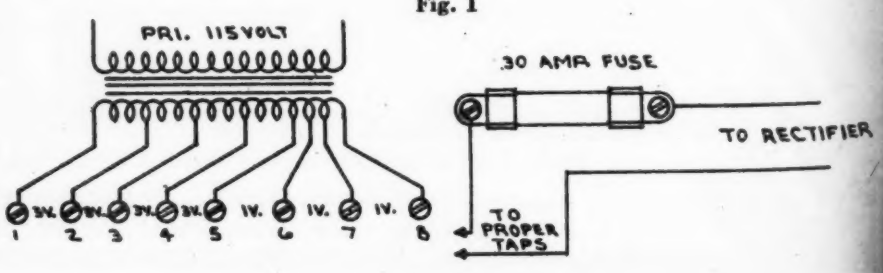
To obtain a secondary voltage of 4 volts connect to taps No. 4 and No. 6.

As the terminal board used for mounting the secondary taps is clearly marked with the voltages between windings as shown, it is only necessary to add the voltages between terminals until the desired voltage is obtained.

As the line or supply voltage may vary between 90 and 130 volts due to line voltage drop, caused by resistance of the feeders at various distances from the power source, the service man may regulate the secondary voltage desired for the rectifiers as follows:

If the line voltage is 100 and 10 volts is the rectifier voltage the ratio of 100 is to 10 as 115 is to 11.5 or the 12-volt connection would be the proper secondary to connect to the rectifier or inversely if the line voltage is 130 volts and 10 volts is desired the ratio of 130 is to 10 as 115 is to 8.85 or the 9-volt connections would be the proper secondary to connect to the rectifier.

Fig. 1



*Presented before National Association of Corrosion Engineers, Houston, Texas, April, 1944.

When "CLEVELANDS" PACE THE PIPELINE JOBS

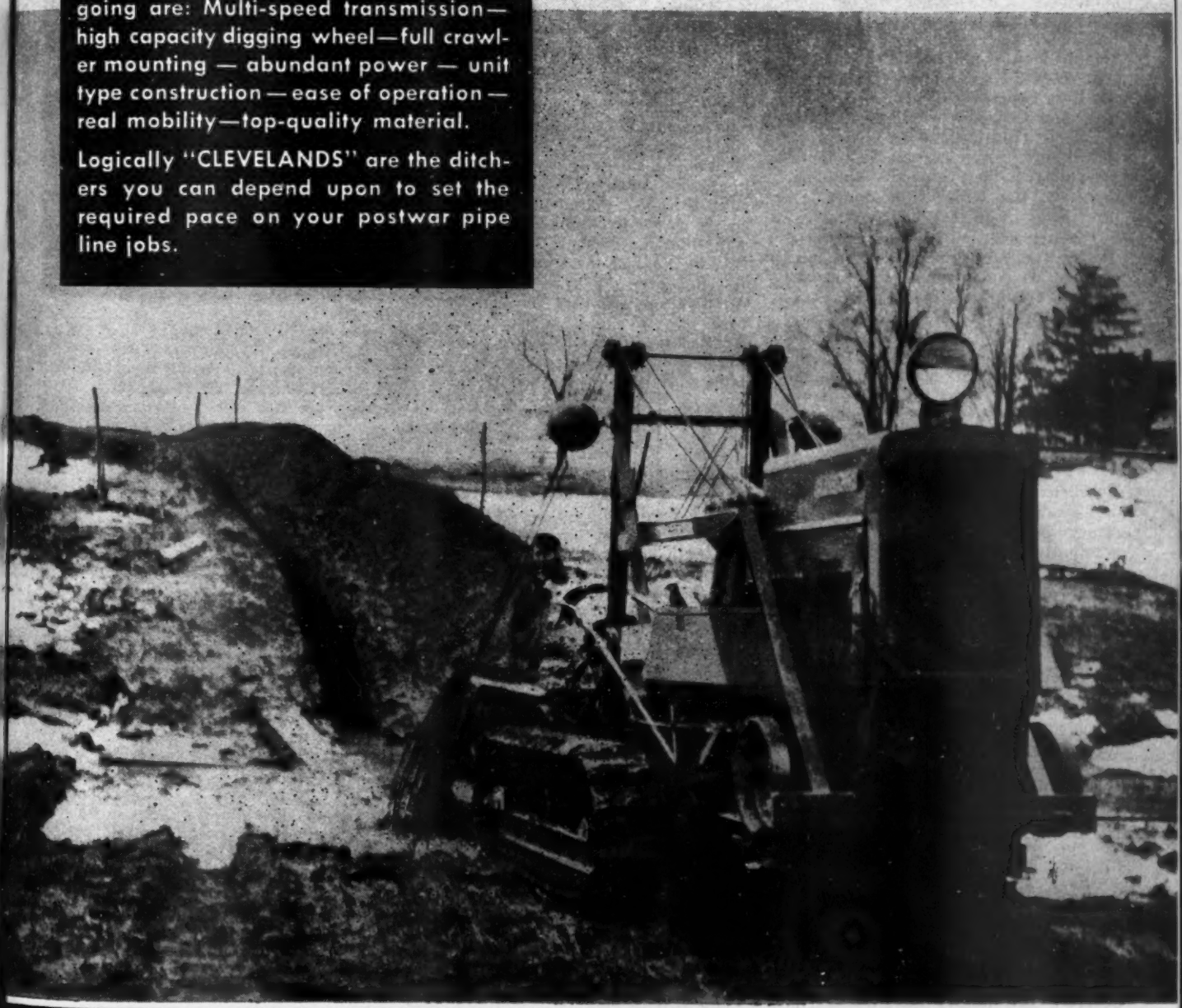
Upon the speed of the ditching gang depends the pace of the rest of the job.

"CLEVELANDS" can be depended upon to set a fast, steady pace. They're the "workingest" ditchers you ever saw or used. They dig in and keep digging . . . make every minute count . . . get the jobs done ahead of schedules.

Some reasons why "CLEVELANDS" are such swell pacemakers in any kind of going are: Multi-speed transmission—high capacity digging wheel—full crawler mounting — abundant power — unit type construction — ease of operation — real mobility—top-quality material.

Logically "CLEVELANDS" are the ditchers you can depend upon to set the required pace on your postwar pipe line jobs.

Time Is Gained . . .
Schedules Are Met . . .
Cost Goes Down . . .



THE CLEVELAND TRENCHER COMPANY
20100 ST. CLAIR AVE. *"Pioneer of the Small Trencher"* CLEVELAND 17, OHIO

"CLEVELANDS" Save More . . . Because they Do More

It is important not to connect any two terminals of the secondary together, as this would short circuit that particular section of the winding resulting in either opening the fuse in primary or burnout of the transformer.

As the secondary is wound with the same wire size throughout the winding the current rating is the same for all voltages so that if the secondary maximum voltage is 15 volts and the rated capacity of the transformer is 300 va. the maximum current of the secondary is 300 divided by 15 or 20 amp. If 10 volts is the desired secondary voltage the transformer capacity is reduced to 10 times 20 amp. or 200 va. Volt-ampere ratings for transformer capacities must be used as they may be connected to reactance loads such as solenoids, chokes, rectifiers, etc., which operate at low power factor. If the transformer capacity were rated in watts it would result in overloading the transformer in many installations. For example, if the load power factor is 60 per cent and the transformer rating is 100 watts, the volt-ampere load would be 100 divided by 0.60 or 166-2/3 volt-amperes. This would result in a current overload in both primary and secondary windings of 66-2/3 per cent. Transformers are always designed for a given current or amperes and voltage in their respective windings; therefore, the term "volt-amperes" is used generally for capacity ratings.

The primary and secondary connections on the transformer are in the form of screw terminals mounted on a heavy panel supported between brackets locked to the core of the transformer. The copper and iron densities are extremely conservative so that the efficiency will be at its maximum and the temperature rise of the transformer under full load will be approximately 40°C. rise computed by the resistance method.

▼ **Efficiency.** Although rectifier circuits are generally considered low in efficiency due to their poor power factor, it is important that the transformer be as efficient as is consistent with good design. This is accomplished by keeping the no load wattage (core loss) at a minimum by using a high grade low loss electrical steel and by reducing the resistance of the windings so that the voltage drop under full load conditions will be low and have a proper balance between copper and steel. The core loss is further dependent on the design of lamination and the proper cutting and annealing of the steel comprising the core or magnetic path of the transformer. For non-aging of the core (maintaining low core loss for long periods of time) it is important that the proper grade steel be used and that all stresses are removed in the annealing process. Transformers made for this system are so produced.

▼ **Factory service test under high temperature and humid conditions.** The transformers in this test were two Jefferson catalog No. 637-001-048 having the following electrical specifications:

300 va. 60 cycles Prim. V 115, Sec. V 15 at 20 amp.
Shell type core 2¼-in. Stack F-29 annealed
Primary—220 turns of No. 16 EC
Secondary—30 turns tap 6, 12, 18, 24, 26, 28 turns of No. 8 Sq. D.C.C.

	Primary	*Secondary*	*Core temp., °C.*
Resistance of unit (No. 1)	0.5645	0.01953	22.5
Resistance of unit (No. 2)	0.5680	0.01952	26

The exciting current and core loss of each unit:

	Primary	*Primary W*	*Primary A*	*Secondary A*
Unit No. 1	115	5.28	0.258	0
Unit No. 2	115	5.40	0.206	0

▼ **Heat test.** The temperature test to prove the construction and design of these transformers was made in a heated box 24 in. by 24 in. by 24 in. with a thermostat control to maintain an ambient temperature of 41.5° plus-minus 0.5°. This test was continued for a period of 33 days with a dielectric check twice each week. The dielectric check consisted of 4000 volts applied between all parts of the transformers without failure of the insulation.

The test was run with the primary at rated voltage of 115 volts and the secondary with 125 per cent load. The secondary windings were connected to be bucking and excited to circulate a current of 25 amp., which is 125 per cent normal load. A thermometer was placed on the core of each transformer to determine the transformer temperature. The bucking method of loading transformers is commonly used by most groups conducting temperature tests on transformers.

After operating for 4½ days the temperature rise of the windings were calculated with the following results:

	Prim. rise, °C.	*Sec. rise, °C.*	*Amb. temp., °C.*	*Core temp., °C.*
Unit No. 1	53	45	41.5	71
Unit No. 2	50	45	41.5	71

During the test the transformers maintained a core temperature of 69°C. plus-minus 1.5° with an ambient temperature of 41.5°C. plus-minus 0.5°C. The humidity during the test was approximately 20 per cent.

The second part of the test was made with the units in the humidity box in the chemistry laboratory. For this test the load conditions were the same as in the previous test with rated primary voltage of 115 volts and secondary with 125 per cent load.

During the first 12 days of the test there was no thermostat to control the ambient temperature so the humidity in the box varied from a small percentage to approximately 96 per cent. At the end of this period a thermostat was installed to maintain an ambient temperature of 47°C. plus-minus 5°C. At this temperature the humidity was between 40 and 50 per cent.

The units were removed twice each week for the duration of the test which was 34 days and a potential of 4000 volts applied between all parts without failure.

The various heat and moisture cycles conducted on these transformers at 125 per cent loading may be considered the equivalent of many months of hard usage in service as the windings and insulation were subjected to expansion and contraction, drying and moist air conditions. As the transformers were in A-1 condition at the conclusion of these tests, they were considered satisfactory for this service.

▼ **Factory methods.** Probably a word picture of a trip through our factory, describing briefly the equipment used for fabricating and processing transformers of this type, would be most appropriate for a better understanding of this electrical device.

▼ **Tubes for coil foundation.** Tubes are produced by automatic machines spirally winding gummed kraft paper, passing through distilled water on steel forms of the proper size and heavy rollers press and form the tubes into square or rectangular shapes. These machines produce many thousand tubes daily to take care of the great variety of coils that will be wound on the automatic winding machines.

▼ **Coil winding.** At the semi-automatic winding machines, the coils are wound in multiples of from 15 to 28 coils on a single tube. One operator supervises the operation of each machine to be certain that the magnet wire insulation is inspected all through the coil and the layer insulation of single, double, or triple thickness is inserted between every layer. This insulation is let in automatically so that it is not necessary to stop the machine for each layer. The tension devices used on each wire are very uniform so that the coil build will be consistent with the specifications.

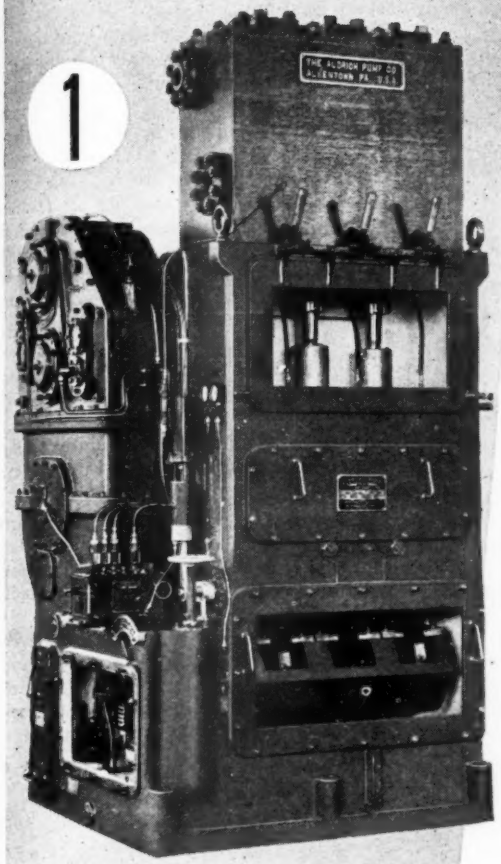
After winding the arbor of coils they are cut apart by a machine equipped with razor sharp band-saw blades. The coils are then conveyed to the finishing department in clean wooden boxes and checked for turns and insulation prior to finishing of the coil ends. These are brought out in many different ways, some with heavy terminal boards, others with flexible leads and anchored on hard fiber panels. These connections are copper brazed, silver soldered, or lead tin soldered to make a good electrical connection.

▼ **Vacuum treatment.** After the coils have been finished they move to the vacuum treating department where they are put on hard wooden forms suitably braced and locked to prevent possible deformation. After a vacuum cycle of several hours, which has removed approximately 1 to 2 gal. of water from the load of several hundred coils, a special beeswax rosin impregnating compound is let into the tank while still under vacuum. This wax, which is heated at about 235°F. thoroughly impregnates the coils and after remaining in this fluid for about 30 min. it is drained back into the container while still under vacuum, and the load is permitted to drain for a period of 15 min. The coils are taken out of the vacuum tank and the wooden forms removed.

▼ **Core laminations.** The lamination steel is brought into the factory in

ALDRICH PUMPS

for PIPE LINE, OIL FIELD and REFINERY SERVICE



1 ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMP

High mechanical reliability combined with low power consumption proportional to varying output demands and a ready accessibility of all totally enclosed and pressure lubricated parts have made this pump a favorite with oil operators. Provides for automatic or remote manual control of delivery from zero to full rated capacity at constant pump speed. For pressures from 300 to 15,000 p.s.i. Write for Data Sheet 65.

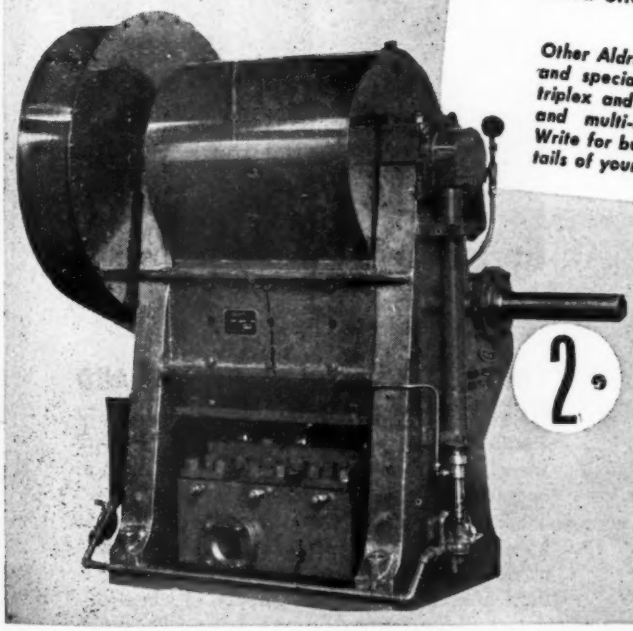
2 ALDRICH WATER FLOODING PUMP

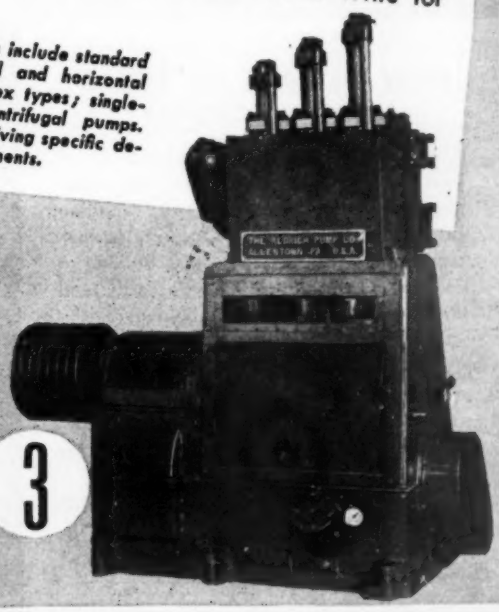
Vertical Triplex, forged steel fluid end, totally enclosed pump housing. Special pressure feed lubrication through rifle-drilled crankshaft to all bearings. Capacity 61.7 GPM at 100 RPM against 2215 lbs. pressure. Write for Data Sheet 25.

3 ALDRICH INVERTED VERTICAL TRIPLEX PUMP

Fluid end mounted at top of frame with crankshaft at bottom, for connection to prime mover at floor level. Pressure feed lubrication through rifle-drilled crankshaft. Drive arrangements can be direct through gear-head motor, by chain, flat or V-belt from extended crankshaft, or through built-in pump gearing from extended pinion-shaft as shown. Outboard plungers can be sealed dust and weather tight with a removable cover. For pressures to 8350 p.s.i. and capacities to 200 GPM. Write for Data Sheet 66.

Other Aldrich Pumps include standard and special vertical and horizontal triplex and quintuplex types; single- and multi-stage centrifugal pumps. Write for bulletins, giving specific details of your requirements.





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FOR PUMPS AND HYDRAULIC EQUIPMENT

THE ALDRICH PUMP CO.

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freight car lots, and run through slitting machines to cut it to its proper strip for punching. The strip runs through the punch press and the laminations are stacked automatically.

▼ **Annealing.** These large stacks of laminated steel are loaded onto a flat car and hoisted into an electric annealing furnace where they are subjected to a temperature of 1500°F. for 8 hr. During the annealing cycle the laminations are protected from oxidation by covering with a metal box and letting gas into the furnace throughout the cycle. The load is removed from the furnace at completion and placed in a slow cooling chamber for a period of 12 hr.

▼ **Assembly of iron in coils.** The coils and laminations that have been processed and tested are now ready for assembly by stacking or press fitting in automatic machines or manually with gauges to check the proper amount of steel loaded through each coil (which comprises both primary and secondary windings). Tests are made in accordance with the specifications that include exciting current, core loss, insulation, and primary and secondary voltages. After this the core is clamped with brackets and the assembly is sent to the varnish conveyor or vacuum tanks for final impregnation and baking.

▼ **Case and terminal finishing.** The core and coil assembly is sent to one of the various departments where the unit is assembled in an enclosure usually of steel and the terminals are connected to the various leads of the transformer. These connections are copper brazed, soldered or silver brazed and the entire transformer is then tested for loading losses and insulation ready for filling with compound, oil or dipping process.

▼ **Cases and brackets.** The cases are fabricated of sheet steel usually ranging from 20 U. S. gauge to 12 gauge, either drawn through several dies or formed in sections and spot or arc-welded, silver brazed, or riveted as desired. The assembled case is then cleaned of all oil and foreign matter in the automatic degreaser and is ready for plating hot tin, hot zinc, electro tin, or zinc plating or enameling through conveyors or sprayers, which are of the semi-automatic type.

▼ **Compounding or finishing operations.** The transformer is now ready for its final impregnation. If cased, the entire unit is preheated in steam-heated automatic temperature controlled ovens with large blowers for air acceleration, for a period of one to several hours dependent on the size of the unit. Immediately after removing from the oven, compound is let into the case at a temperature of 350°F., which, because of the preheating cycle, freely fills all restricted pockets and seals both coils and terminals of the transformer. If a case is not used the core and coil are dipped into a special compound after the preheating cycle for moisture proofing.

▼ **Final testing and packing.** The completed transformer is then checked for electrical and mechanical specifications and, if it meets the requirements, is cleaned and packed ready for shipment. For a checkmate on production inspection, quality control engineers, as well as mechanical engineers, operate in conjunction with the engineering department in selecting samples from production runs daily to insure against poor workmanship or testing and inspection.

▼ **Engineering laboratories.** We have now progressed through the production department and we visit the chemical laboratory staffed by a chief chemist and assistants, who constantly check all raw materials for quality and freedom from acids that may cause transformer failure.

The engineering research laboratory is well equipped with instruments and engineers to develop new devices or materials that are always coming to the fore to improve and perfect transformers in their many kindred forms.

The production engineering department has three department heads and their assistants to design and develop production specifications covering (1) radio transformers, chokes, etc.; (2) general purpose transformers, power, oil-burner, ignition, fuses and solenoids, and switches, and (3) a drafting department to provide layout design and drawings for all units to be manufactured.

★ ★ ★

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THE ADVANCED ENGINEERING AND DESIGN of Honan-Crane "Continuous" Oil Purifiers will give maximum protection for any Diesel engines or compressors under any kind of operating conditions. Honan-Crane "Continuous" Oil Purifiers accomplish thorough purification by removing all types of contamination as fast as they are liberated in the oil. Your engine is lubricated by a constant supply of clean oil.

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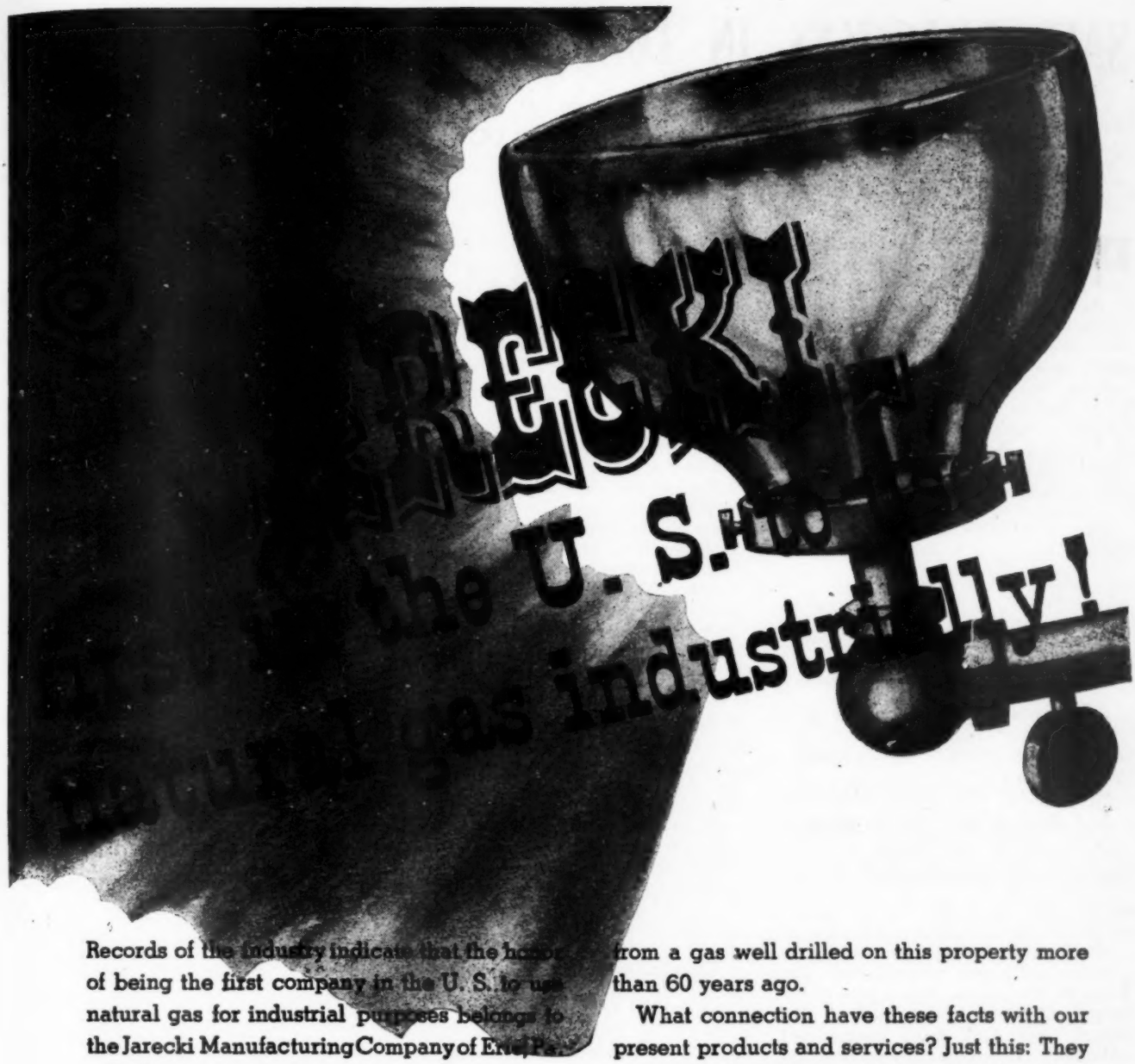

Records of the industry indicate that the honor of being the first company in the U. S. to use natural gas for industrial purposes belongs to the Jarecki Manufacturing Company of Erie, Pa.

In the very early days of our company, now 92 years old, foresighted men drilled a well on our foundry lot. For years that well served as our source of power and light.

Among the first to use natural gas for domestic purposes was Alex Jarecki, our late president. His country home is heated by gas from a gas well drilled on this property more than 60 years ago.

What connection have these facts with our present products and services? Just this: They prove that Jarecki's association with the oil industry, both as a source of supply and as a user of its products, dates practically from the beginning of oil production in the United States.

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BRANCH STORES AT ALL IMPORTANT PLACES IN THE OIL COUNTRY

SAFE PRACTICES IN LOADING GASOLINE TANK CARS

By DON ATTAWAY, *Arkansas Fuel Oil Company*

EXCLUSIVE THE one great hazard in loading gasoline into tanks cars is from fire. This is due to the volatility of the liquid, which releases inflammable and explosive vapors, and the numerous ways in which these vapors may become ignited.

Recently, several cases of carloaders being burned to death as a result of ignition of tank cars or gasoline-soaked clothing have been recorded. These accidents were horrible and costly examples of the incorrect methods used for loading gasoline.

Fires at loading rack, however, are not the most common source of accidents. The carloader works aboveground much of the time and is exposed to the hazard of slipping or falling, to strains, and even asphyxiation. His duties on the ground expose him to the danger of falling objects such as dislodged tools, tank dome covers, and walkplanks. It is from these sources that the most accidents at a loading rack occur, though their severity seldom equals the extent of fires or explosions.

Observation of correct methods minimizes possibility of accidents at loading racks that may result in serious injury or death to workmen.

The purpose of this article will be to set forth certain safe practices, based on actual experience of the writer as well as other accepted methods, to assist loaders in avoiding situations and mistakes that might result in fire or accident. These safe practices are not to be confused with requirements of federal or state regulations as well as insurance and national safety codes. They are confined to loading rack operations at natural gasoline plants wherein the production is either motor fuel or casinghead gasoline and does not include liquefied petroleum products or leaded gasoline.

Furthermore, the type of rack concerned is the typical natural gasoline plant installation, usually situated on a railroad spur and operated by one or two men. Often these racks are some distance from the plant. Others are on the plant site proper. In many cases, a lone man attends the operation of these isolated racks and it is principally for his benefit and safety that these practices are set forth.

▼ **Inflammability and toxicity of gasoline vapors.** To understand intelligently the hazards, all carloaders should know the characteristics of gasoline. An inflammable liquid, according to the Bureau of Explosives, is any liquid that gives off inflammable vapors (as determined by flash point from open-cup tester) at or below a temperature of 80° F. As the flash point of gasoline is approximately 0° F., it meets this requirement.

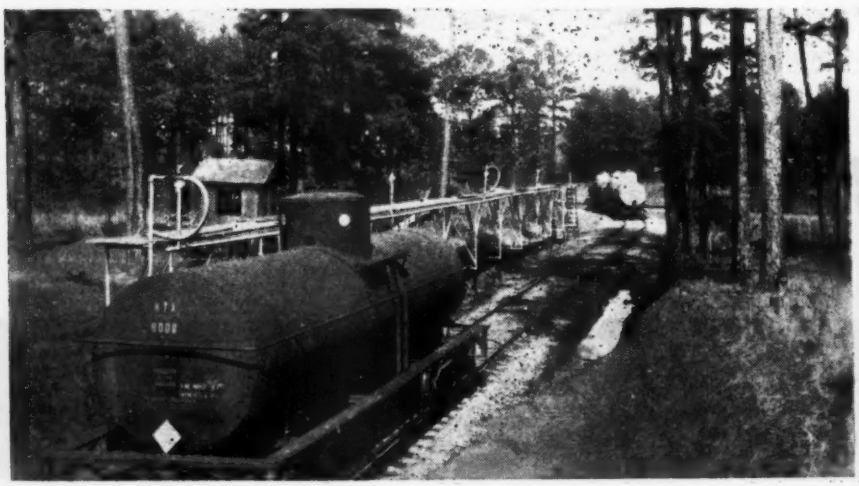
Chemists have determined that a mixture of air containing 1.5 to 6 per cent gasoline vapors, if ignited, will explode. Mixtures greater than 6 per cent gasoline will burn readily if 12 per cent or more oxygen is present to sustain combustion, whereas concentrations having as little as 0.2 per cent gasoline vapors combined with air may be combustible under favorable conditions.

Air containing more than 0.2 per cent gasoline vapor is likely to asphyxiate workmen.

Gasoline vapors are not toxic and leave no lasting effects except when the gasoline has been blended with tetraethyl lead or other known poisons; however, exposure to ordinary gasoline vapors from 7 to 15 min. in concentrations as low as 0.5 per cent produces effects such as vertigo, hilarity, inability to walk straight or maintain balance. These conditions can last as long as one hour after exposure and many loaders have felt these symptoms after inhaling vapors during car loading.

▼ **Qualifications of loaders.** Consequently, great care must be taken in handling and loading tank cars and only men physically fit and instructed in proper and safe procedures should be engaged or permitted to do this work.

Typical loading rack showing two methods of exit. Note warning sign on rack.



Typical loading rack for natural gasoline plants.

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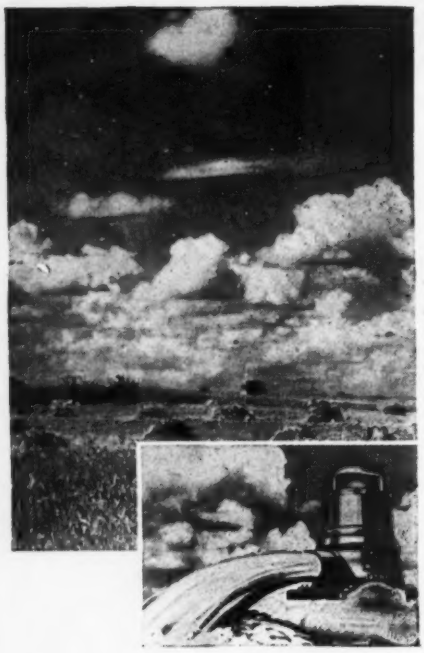

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The idea that most any man can perform this task is a fallacy and the use of unskilled, untrained, and uninformed carloaders has resulted in serious disasters.

The carloader should be familiar with the rules and regulations of the Interstate Commerce Commission, the Bureau of Explosives, and the National Board of Fire Underwriters. All these organizations have set forth safe practices to prevent fires and explosions endangering lives and property when gasoline tank cars are loaded or moved over railroads.

The carloader should know the fundamental specifications of the Association of American Railroads set forth for the type and equipment required to transport gasoline by tank car.

▼ **Loading racks.** Loading racks should be located at least 100 ft. from any building. Care should be taken in locating the rack so that it does not drain into streams of water where it may damage farms or kill stock. Isolated racks should be fenced and the area posted with proper warning signs against trespassers. Approaches should have "Danger" and "No Smoking" signs prominently displayed.

Gasoline flowing through a pipe generates static electricity and every rack should be equipped with a bonding line from the loading connection to the shell of the car and a bonding line from the track rails to the loading rack supply line. This sets up a continuous circuit that eliminates the possibility of static charges building up.

All loading racks used at night should be well illuminated, if at all possible, and electric wiring must be installed in vaporproof conduit and vaporproof globe covers used on the lights. All broken covers should be replaced immediately.

Telephones and electric switches should be encased in vaporproof noninflammable boxes. If possible, these should be situated 100 ft. or more from the nearest loading station.

Railroad switch lights must not be lighted or burned during loading operations.

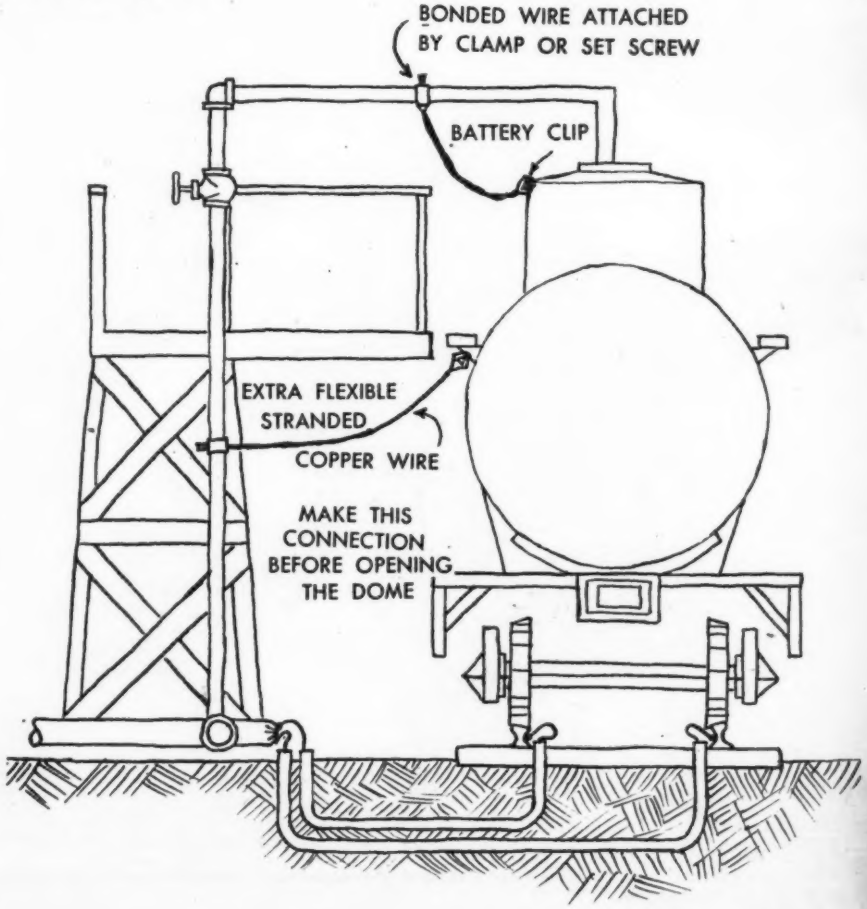
All lines to and from the rack should have remote shut-off valves. Lines underground to the rack should be at least 3 ft. deep and, if under railroad tracks, at least 4 ft. beneath the ties and properly cased and vented.

Grass, weeds, and other vegetation should be kept cut and cleared away from the loading rack site.

A regular inspection of the rack for these conditions should be made before any loading is done.

▼ **Locomotives.** Coal burning locomotives working on or near a loading rack should be equipped with smoke stacks and firebox screens. In some cases, a hose and water line are provided at

Sketch showing simple method of grounding tank cars. Terminals should be securely fastened to car before opening dome and firmly snapped to rack when not in use.



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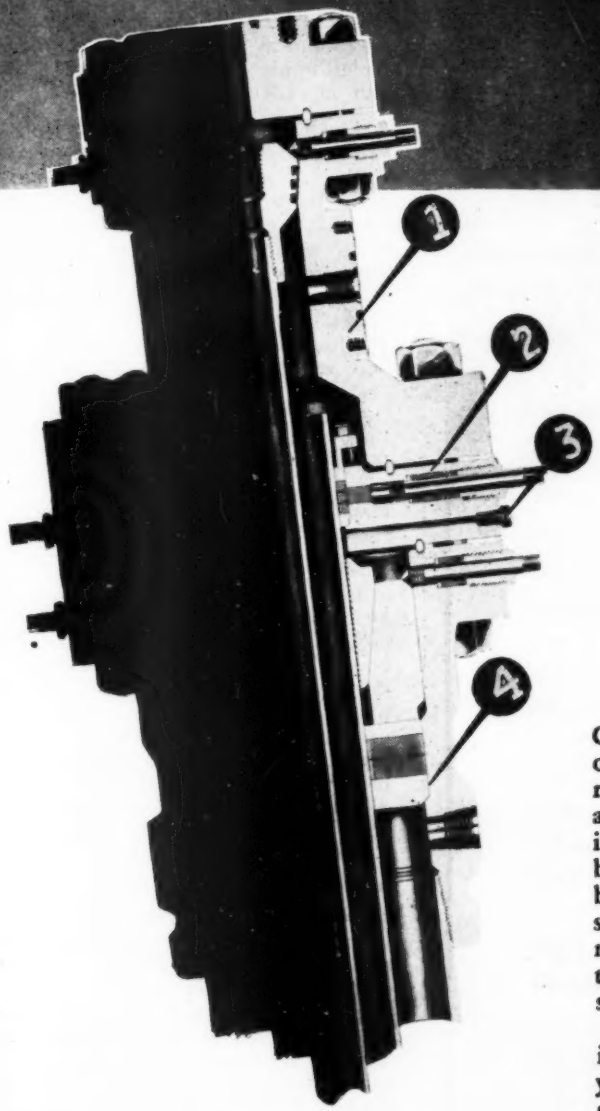

Many Operators Have Wisely Switched to This

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1. O-C-T Type "T-6" Tubing Head—thread suspension and resilient packing with lock-down screws in the top flange.
2. O-C-T Type "PF-1" Packoff Flange—provides auxiliary resilient packing above slips and compression screws to permit tightening seal externally. Pressure test port optional.
3. Passage for subjecting upper and lower seals to hydraulic test pressure before or after completion.
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O-C-T makes a complete line of well head equipment, including welding flanges for operators who insist on this type seal. See your Composite Catalog, pages 2158-2191, for complete details, or write for descriptive literature.

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racks for wetting down live coals in the ash box before engines are allowed near the loading rack. These safeguards are not always possible or feasible and usually these locomotives pick up extra cars to keep a considerable distance away from the rack during switching.

No locomotive should be allowed near the loading spouts or drains where spilled liquid or vapors are present.

Many oil burning engine crews extinguish their firebox fire for the short period they are switching in or on loading spurs.

While the train crew is switching, the loader must not get on, between, or under the tank cars.

Cars should be tied down with the hand brakes once they are spotted on the rack. If it becomes necessary to spot cars by hand, a standard car mover should be provided. The use of a pinch bar has resulted in badly mashed fingers and toes.

Train crews engaged in switching gasoline tank cars, and car loaders using portable electric lights should use only vaporproof lanterns and flashlights. The U. S. Bureau of Mines has tested and approved various makes of flashlights and lanterns and these approved lights are recommended.

▼ **Stop sign.** The Interstate Commerce Commission requires the display of a blue flag stop sign at ends or approaches to tank cars when repair or loading operations are going on. This sign must be left in place until all work has ceased and the rack is safe to enter.

Typical stop sign used at loading racks showing wording and size.

▼ **Catch basins and drains.** Isolated racks seldom have means to recover spilled or drained gasoline; however, some plants with the rack on the plant site have concrete catch basins built between the rails, so that the bottom outlet valve will be over the basin when the car is spotted, enabling the loader to remove the cap and catch the drip gasoline in a recovery line. As all tank cars are not the same length, an extension drain spout is sometimes required.

Other racks simply have drain basin lines or ditch drains to catch spilled liquid and drippings. These drains must not dump into a sewer, for the vapors may be carried to a point of ignition some distance away.

▼ **Walkways and platforms.** Stationary or hinged platforms are built to provide loaders a means of passing from the rack to the car. These platforms should be weighted to be pulled completely in the clear when not in use. A movable plank or foot board is in most common use and has been the cause of many falls. If this is used, the loader should be sure it is in good condition and in secure position. The plank should be at least 14 in. wide and 2 in. thick with cleats and a toe board.

▼ **Opening the screw type manhole cover.** After a standard tank car has been spotted and all conditions made safe, it should be thoroughly inspected externally for evidence of bad order and inspection and test dates checked. Carloaders should be able to detect such hazards as dropped brake-beams, broken axles, loose hand-holds iron and ladders, bad running and foot boards, pulled draw-heads and ordinary visible defects. If the car is of the proper type for the load and in serviceable condition, the loader can now open the dome cover.

If the manhole cover is of the screw type, a short brass bar should be placed between the lugs on the dome cover and the loader stand facing the dome. He

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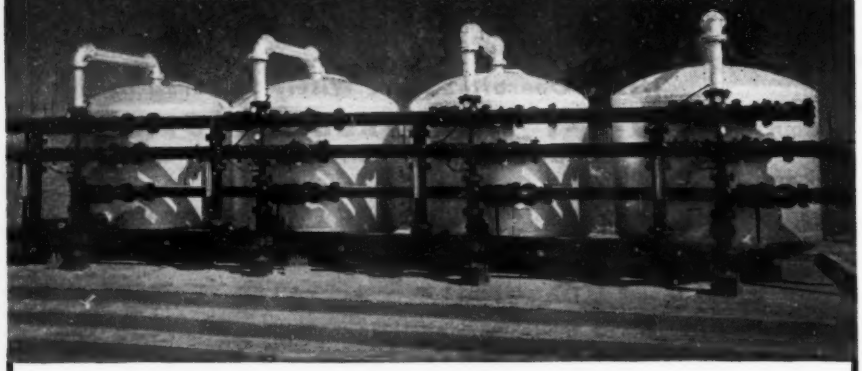

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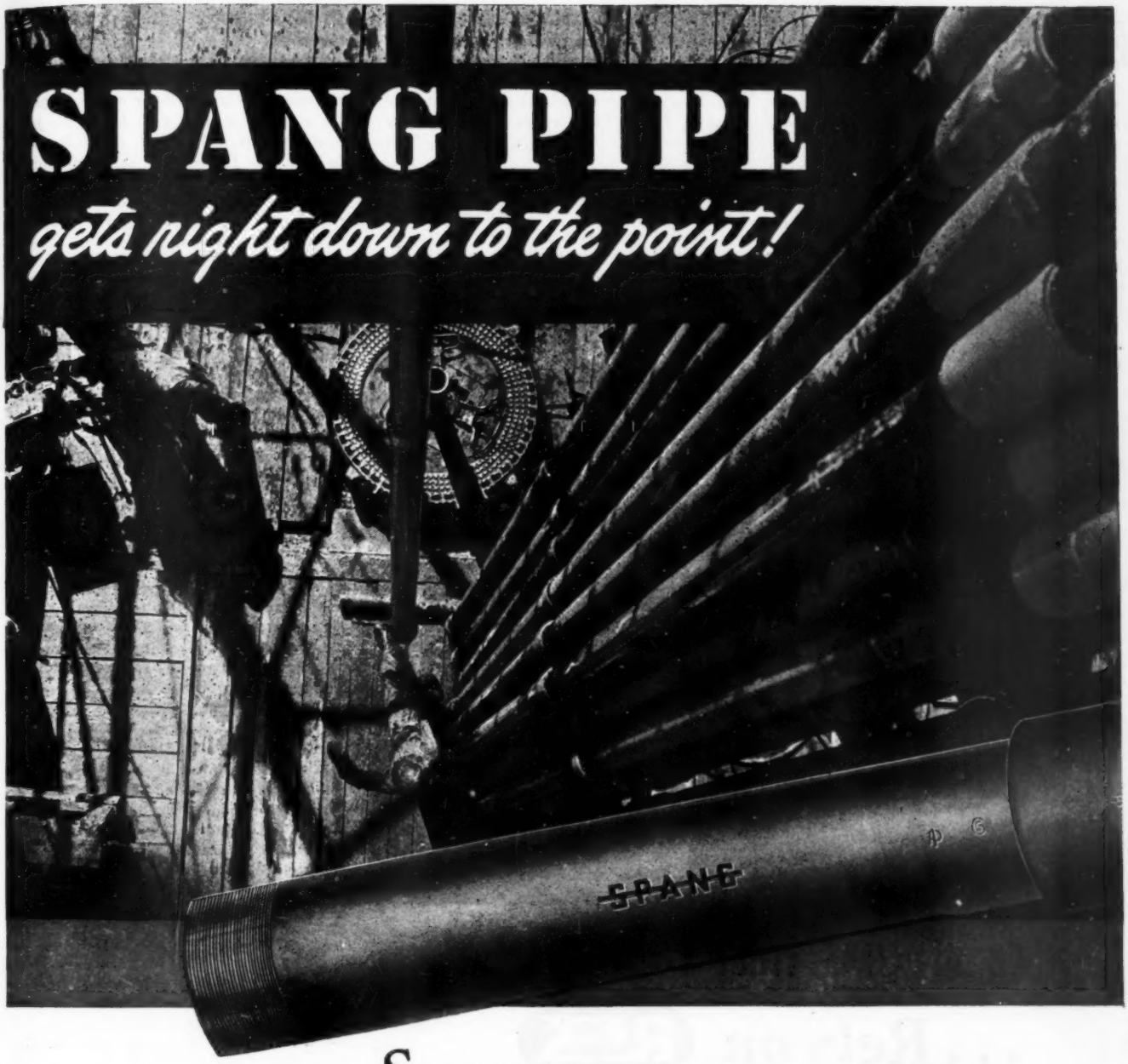

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Every inch of Spang Pipe is made right and test-proved *tight*. It's delivered on time, and helps meet and beat your operating schedules through trustworthy performance under the most difficult conditions. Specify Spang for service!

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should start the thread with short, vigorous pushes against the bar. This is done to prevent back sprains and falls. If the cover is tight, a wooden or leather maul may be used. After a few turns, the side vents in the cover will be exposed and whatever gas pressure exists will be relieved through these vents. The car should be permitted to relieve itself before proceeding with the cover removal.

Care should be taken to avoid striking the cover against the dome and creating a spark. If the cover chain is in good condition, the cover can be left lying to one side of the dome, but if the chain is faulty or unsafe, the cover should be removed to a safe place on the loading rack platform.

The loader should now check the outlet valve to see that it is properly seated. This is done by moving the valve rod handle back and forth a few times. Some tank cars have wheels to manipulate the outlet valve. This wheel should be rotated to see if the valve descends and seats.

▼ **Opening the bolted or hinged type cover.** Many tank cars, usually the insulated type, have the cover shown on page 198. The vent pipe stopcock should be opened slightly to relieve gas pressure before the bolts are loosened. Where the pressure has been dissipated, the bolts can be loosened a few turns at a time in a criss-cross fashion until all bolts are free and the cover can be taken off.

Here, too, care should be taken not to cause a spark. Only non-sparking hammers such as copper or wood should be used on a tank car. Leave no tools lying on the dome, car, or walk plank to fall off. The outlet valve should be checked for seating by moving the wheel or handle back and forth several times. The gasket under the tank car cover should be inspected, and, if faulty, replaced.

▼ **Bottom outlet.** Special wrenches made to fit the bottom outlet cap are best, however, adjustable wrenches may be used, provided they are 48 in. long. The use of a cheater should be avoided.

Care should be taken to avoid damage to the outlet cap and thread and the gasket inspected. During loading, the cap should be left hanging loose with leakage no more than a drip.

▼ **Internal car inspection.** With the dome cover removed and the outlet valve open, the loader should inspect the car interior. An approved flashlight may be used and the loader should stand on the windward side of the opening to keep vapors and fumes out of his face.

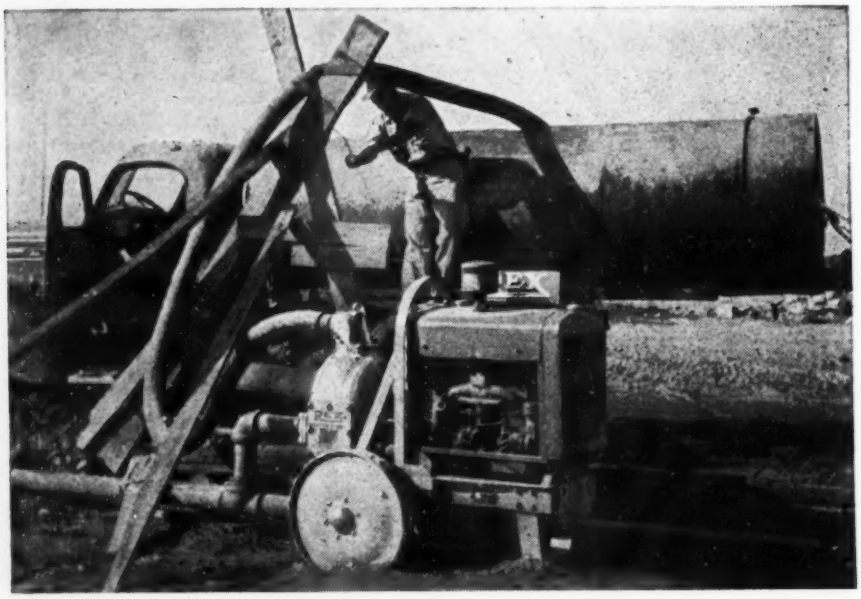
Often tank cars contain such foreign objects as bolts, nuts, rags, bottles, and wooden blocks. These may be removed with a long handle copper grabhook or wooden scoop, as their presence may interfere with the outlet valve seating.

No tank car that is not clean or contains deposits of crude oil should be loaded as the gasoline to be loaded may be contaminated or off-colored. Usually a tank car should only be loaded with a product identical to that which it last contained.

▼ **Entering a tank car.** A loader should never enter a tank car except in an emergency. If it is necessary, a fresh air hose and blower type mask must be used and the man entering the car must wear a life belt and line. Such life belt should have a "D" ring between the shoulders rather than on the waist. At least two helpers must be used in this operation.

▼ **Open dome loading.** Many standard tank cars are not equipped with loading and vent lines and often low vapor pressure gasoline is loaded into these cars through the open dome; however, gasoline with a vapor pressure higher than 10 lb. should be loaded only in insulated tank cars with the proper fittings and equipment.

The procedure for open dome loading is first to seat the outlet valve and then attach the bonding line from spout to tank shell. The spout may then be put into the manhole opening. A rubber hose extension or pipe should extend almost to or rest on the bottom of the car. Loading gasoline by allowing it to squirt or fall from the top to the bottom of the car should be avoided as this causes considerable vaporization with a resultant hazard and excessive loading loss. A loading spout or hose that does not extend into the car interior is in danger of jerking or jumping out of



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Complete with 55 ft. double pole mast, drawworks, choice of diesel or gas-gasoline power plant, and choice of rotary drive or spudding attachment or both. Capacities:
Pull rods and tubing to 5,000 ft.
Rotary cleanout to 4,000 ft. (when supplied with necessary extras.)
Standard cable tool for tailing-in and deepening to 5,000 ft.
Cable tool drilling from grass roots to 3,000 ft.

IN NOVEMBER

THREE Model 5000 DOUBLE DRUM SKID UNITS
(Same features and capacities as listed above.)

FOUR Model 4000 DOUBLE DRUM UNITS

Complete with 55 ft. double pole mast, drawworks, gas-gasoline power plant, and choice of rotary drive or spudding attachment or both. Capacities:
Pull rods and tubing to 4,000 ft.
Rotary cleanout to 3,000 ft. (when supplied with necessary extras).
Standard cable tool for tailing-in and deepening to 4,000 ft.
Cable tool drilling from grass roots to 2,000 ft.

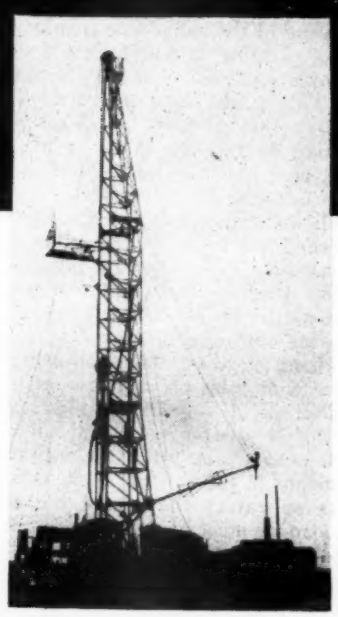
ONE Model SAL 5000 SKID ROTARY RIG

Complete with 96 ft. open face derrick, pump, drawworks with water cooled brakes, and two 200 hp. diesel engines, air controls. Capacities:
5,000 ft. 8¾" hole using 4½" drill pipe.
5,500 ft. 7⅞" hole using 3½" drill pipe.
6,500 ft. 6¼" hole using 3½" drill pipe.

IN DECEMBER

TWO Model SAL 6000 SKID ROTARY RIGS

Complete with 96 ft. open face derrick, pump, drawworks with water cooled brakes, three 200 hp. diesel engines, air controls. Capacities:
6,500 ft. 8¾" hole using 4½" drill pipe.
7,500 ft. 7⅞" hole using 3½" drill pipe.



A Franks Model SAL 5000 Rotary Skid Rig on location.

The above Franks units will be available (subject to prior sale) the balance of 1944 in addition to units already sold on order.

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the dome unless it is firmly tied or fastened to the car.

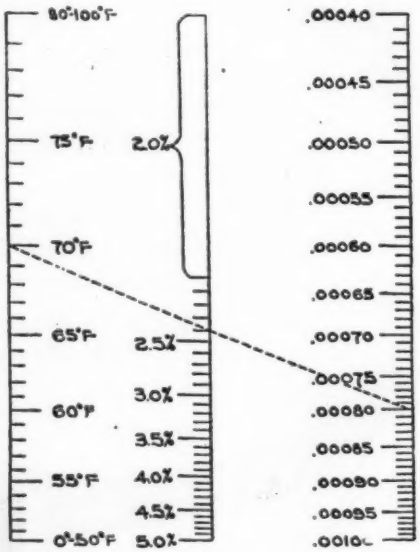
It is good practice to place a water moistened burlap bag around the spout or dome opening during such loading.

Some companies in hot climates make use of a special manhole cover in loading, which leads the excess vapors to a recovery line and maintains a slight back pressure on the car.

▼ **Loading cars under pressure (casinghead).** To load gasoline having a vapor pressure higher than 10 lb., an insulated tank car having loading and vent lines equipped with stopcocks and bullplugs should be used. Many tank car and oil companies, having insulated cars not equipped with loading and vent lines, have taken the dome covers to shops and had two 2-in. collars welded into the cover and fitted with short nipples and stopcocks.

The car is connected as shown on page 198, whereby a gauge line is constructed and introduced into the vent connection. The outlet valve is firmly seated and the dome replaced and bolted down. The loading line stopcock is opened and the loading spout or line is unioned to this connection. The handlebar or winged union is preferred for this connection. The car vent stopcock is left wide open and the gauge connection lowered into the car, the loader noting carefully the mark or notch denoting the shell-full level of the car. This gauge device is screwed into the vent connection and its ventcock opened. Vapors from this outlet can either be recovered or vented to atmosphere or an isolated flare line. The gasoline is then started into the car and the ventcock outlet regulated to hold a back pressure on the car equal to the vapor pressure of the product minus atmospheric pressure.

Interstate Commerce Commission Outage Chart for inflammable liquids.



Example: Suppose the temperature of the liquid at time of loading is 70°F. and its coefficient of expansion is 0.00080; lay a ruler on the chart running from 70°F. to 0.00080 as shown by the dotted line and the required outage is 2.4 per cent where the ruler crosses the outage scale.

Tank car outage table

This table calculated from 1 in. to 15 in. out of shell at a temperature of 60°F.

8,000-gal. tank Inches	Gal.	10,000-gal. tank Inches	Gal.
1	20	1	22
1½	36	1½	40
2	53	2	58
2½	74	2½	80
3	96	3	103
3½	121	3½	129
4	146	4	156
4½	174	4½	186
5	202	5	216
5½	233	5½	249
6	264	6	282
6½	297	6½	317
7	331	7	353
7½	366	7½	391
8	402	8	429
8½	439	8½	469
9	477	9	510
9½	516	9½	557
10	556	10	595
10½	597	10½	639
11	639	11	683
11½	682	11½	729
12	725	12	775
12½	769	12½	822
13	814	13	870
13½	860	13½	919
14	906	14	968
14½	953	14½	1019
15	1001	15	1070

Petroleum products contract or expand approximately 1 per cent for each 20°F. For instance, a car having a capacity of 8000 gal. loaded at 40°F. temperature would expand 1 per cent of its capacity if heated to a temperature of 60°F. Therefore, if the car is shell full at 40°F. we add 1 per cent of the capacity, or 80 gal. to 8000 gal., which will indicate the car contains 8080 gal. at 40°F. If the car of 8000-gal. capacity is loaded at 80°F. we deduct 1 per cent of the capacity, which will mean that the car only contains 7920 gal. when shell full at 80°F.

As the car approaches the shell-full limit, the gauge line should be lifted upward through the stuffingbox above the liquid level and the ¼-in. valve opened. Free vapors will blow out this opening. As the line is slowly lowered, vapors will continue to blow until the open end of the gauge line is submerged in the gasoline, at which time a stream of liquid will emit from the ¼-in. opening. This marks the point of the liquid level in the car and by checking the position against the notch or mark on the gauge line, the loaded condition of the car can be determined.

When the liquid level coincides with the shell-full mark on the gauge stick, the gasoline should be shut off.

The loading and vent connections must not be broken before the tank car stopcocks are closed.

During loading the bottom outlet valve should be checked for excessive leaking. If it is considerable, loading should be discontinued and an effort made to seat more firmly the outlet valve by means of the control in the dome. If leaks appear at the seams and rivets, the loading must be stopped and the car emptied and reported in bad order.

The loader should not leave the vicinity of the loading rack during operations.

▼ **Completing and sampling the load.** Interstate Commerce Commission rules make it unlawful to load a tank car above the top of the tank shell and provides a table of temperatures and gravities by

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Now Available . . . A Removable Pack-off and Locking Assembly suitable to withstand

10,000 p.s.i. PRESSURE and 350° TEMPERATURE

for All Types of OTIS Sub-Surface Controls

Legend

1. Flow Coupling
2. Retaining Nut
3. Lock Mandrel
4. Slip Carrier
5. Slip Carrier Band
6. Mandrel Band
7. Slips
8. Landing Nipple
9. Male Packing Adapter Ring
10. Packing
11. Female Packing Adapter Ring
12. Packing Mandrel
13. Packing Mandrel Nut
14. Sub-Surface Control

The New OTIS TYPE *E B* CHOKE

The new Otis Type EB Choke represents the latest design in subsurface pressure control and provides an easily removable, yet a most positive, lock and packoff assembly for subsurface regulators, chokes, plugs, safety valves, etc. The original purpose of the tool was primarily to withstand extremely high subsurface temperatures and pressures; however, the fact that it is simple to run and pull, plus additional features, makes it most desirable for any removable subsurface control installation. This tool, like all other Otis subsurface tools, is run and pulled under pressure on an ordinary steel measuring line.

The Type EB Choke differs from the regular Type B Choke in that it is necessary to have a Type EB Landing Nipple in the tubing string for the EB Choke to seat in. It will not seat elsewhere; consequently, the choke has only one fixed depth at which it will set. It is necessary, of course, that the Landing Nipple be installed in the tubing string at the time the well is tubed. Because the bore of the Landing Nipple is slightly restricted, it is important that it be placed below the maximum anticipated swabbing depth. Bottom hole pressure bombs, samplers, etc., can, however, be run through the Landing Nipple without trouble.

THE PRINCIPAL ADVANTAGES OF THE EB CHOKE ARE AS FOLLOWS:

1. ***Heat Resistant Packing Element***—The slightly restricted Landing Nipple makes possible the use of the new asbestos-base heat-resistant packing now used so successfully on the Otis Side Door Choke. This packing easily withstands the highest subsurface temperatures and pressures and is inert to acids, alkalis and sour crudes.

2. ***Unnecessary to Flow Well to Set Packing***—The packing fits snugly in the restricted nipple; therefore, it is not necessary to flow the well hard to cause the initial shutoff. This is particularly important where there is danger of pulling sand into the tubing string by flowing the well at an excessive rate.

3. ***Simple to Run and Pull***—Because the O. D. of the Type EB Choke is smaller than the regular Type B, the new tool is easier to run and pull through crooked tubing, paraffin deposition, etc. The setting and pulling operation is simpler and the preset packing always assures a positive shutoff regardless of the pressures encountered.

4. ***Flow Coupling***—A special flow coupling, much heavier and longer than standard couplings, is used immediately above the Landing Nipple to reduce the possibility of abrasive flow cutting through the tubing.

5. ***Positive Lock***—The lock employed on this tool is the same as that used so successfully on over 1200 Otis Side Door Choke installations.

We recommend the installation of an EB Landing Nipple with the tubing string in every well in which there exists the possibility that the use of subsurface controls may be advisable.

Branches: Houston, Corpus Christi and Wichita Falls, Texas; Hobbs, N. M.; New Iberia, La.; Magnolia, Ark.; Oklahoma City, Okla.

Representatives: Otis Eastern Service, Inc. Wellsville, N. Y.; Western Pressure Control, Los Angeles and Bakersfield, Calif.

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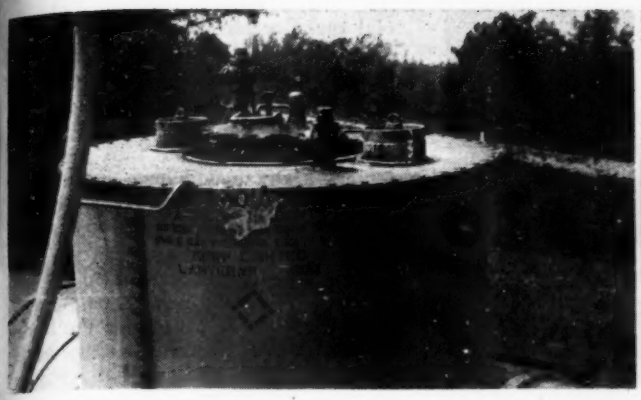
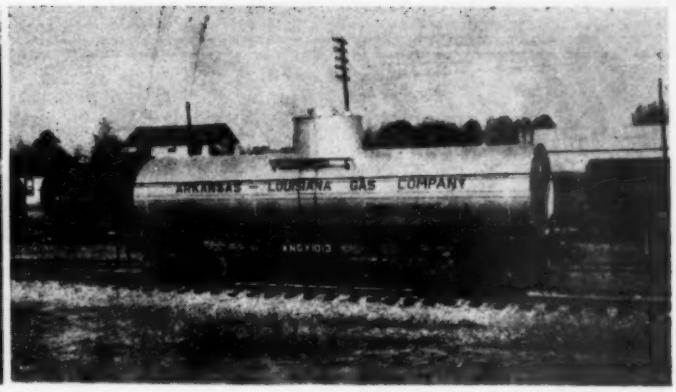




Left: Appearance of bolted type dome cover having ventcock on dome and loading line through shell. Note bull-plugs in openings. Right: Example of standard insulated tank car used for natural gasoline shipment.

which the correct outage can be checked. In all cases, the car must not be so loaded that it will be filled with liquid at 105° F.

Overloaded tank cars, if subjected to a temperature rise, may leak around the dome and through the safety valve. These fumes could become ignited.

If loading is done open-dome, the loading hose or spout should be drained thoroughly before removing from the

Car loader taking sample in glass bottle. This is not a good practice.

car. Loading line valves that do not make a positive shut-off should be repaired or replaced.

The taking of samples from an open-dome car is simple but must be done carefully. Thermometers, sample thiefs, and chains should be of copper or aluminum to avoid striking sparks.

To sample the pressure loaded car, the use of the gauge line must be used to procure the specimen for the distillation test. The pressure type sample chamber of the standard vapor pressure bomb can be screwed to the threaded end of the ¼-in. line and the sample drawn. Once the chamber has been correctly filled, it should be immediately made up on the bomb air chamber and the connecting valve opened. Otherwise, a rise in temperature may cause the chamber to rupture. To obtain the car liquid temperature, fluid should be drawn into a 1000-cc. graduate in which an immersion type thermometer has been placed. This reading should be made quickly to offset the effect of atmosphere temperature.

The use of glass bottles for samples should be avoided. Metal containers with screw tops are better. Thermometers, graduates, and hydrometers should be kept in a felt lined case so that they will not be broken.

▼ **Sealing the car.** After all sampling is completed, the car should be closed and sealed as soon as possible. If it was loaded open-dome, the manhole cover gasket should be inspected and replaced if faulty. The dome cover should be carefully lowered in place (not dropped) and firmly bolted and checked for leaks of vapor.

If the car were loaded under pressure, the stopcock on the car loading line should be firmly closed and the union connection broken loose and removed. The gauge device may be removed by drawing the ¼-in. line to the full top and then firmly closing the car stopcock. The gauge assembly may then be disconnected and unscrewed from the connection. Flat or bullplugs should be firmly made up in the tank car vent and loading stopcocks to eliminate vapor or liquid escaping should the cock be accidentally opened during transit.

Next, the bonding line connection can be removed and safely snapped to the ground wire while not in use.

The outlet valve cap should then be replaced after making certain the gasket is in good condition. A long handle wrench, as previously described, should be used and no sign of a leak must be allowed after the cap is firmly in place.

▼ **Car placards.** The four inflammable placards, one on each side and one on each end, indicating the car contents are next attached. Most cars have metal frame holders, but others make it necessary to use flat head nails for fastening the cards. If the car is not equipped with a dome caution stencil as shown in column 3, then placards of white paper must be glued, one on each side of the dome near the ladders.

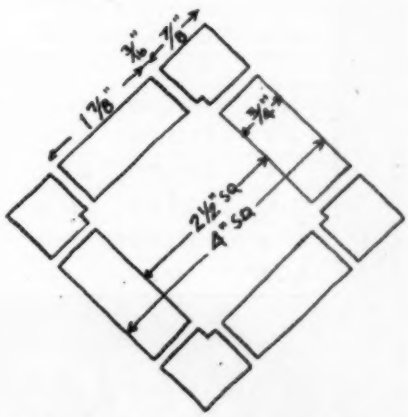
▼ **General.** It is recommended that loaders wear leather shoes with pegged heels and sewed soles. Woolen work clothing

AVOID ACCIDENTS

DO NOT REMOVE THIS DOME COVER WHILE GAS PRESSURE EXISTS IN TANK

KEEP LIGHTED LANTERNS AWAY

Replica of dome caution placard required on tank cars. Black printing on white paper. Measures 4⅛ in. by 10⅞ in.



Sketch of manhole closure identification mark required on gasoline tank cars.

carries impregnated vapors and should be avoided. It is a safe practice for the loader to change clothing before and after loading operations.

In the event of an electrical storm, loading should be discontinued and cars capped. Special precautions should be taken during winter weather when ice and sleet make slipping very hazardous and vapors tend to cling to the ground. Ashes, cinders, and sawdust make fair abrasives to reduce slipping.

If it is necessary to move a car before it is fully loaded, it should be completely capped and sealed.

Automobiles should be kept away from the vicinity of the loading rack. Backfires or hot exhaust carbon may ignite vapors.

Welders should never work in the vicinity of the rack except by special permit, which should only be issued after proper safety precautions are taken.

All tools, material, and debris should be kept clear of the rack and walkways as they create stumbling hazards. Spe-

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Economy in performance is the first essential of Lunkenheimer valve design . . . every detail is carefully planned to insure tightness and long life with lowest possible outlay of time, labor and money for maintenance.

Glance at the chart immediately following. These startling figures show what leaky valves can waste . . . and conversely what good tight valves can save. Where Lunkenheimer valves are on the job and given ordinary care, these losses are held to a bare minimum.

Always helpful is the nation-wide Lunkenheimer distributor organization. There's one near you with complete facilities to serve you.

AREA OF LEAK	AIR		STEAM		WATER	
Diameter Inches	Number of cubic feet per month at 75 lb. pressure	Total cost of waste per month 11c per 1000 cubic feet	Pounds wasted per month at 160 lb. pressure	Total cost of waste per month 65c per 1000 lb.	Gallons wasted per month at 60 lb. pressure	Total cost of waste per month 16c per 1000 gallons
1/2"	13,468,000	$1,481.44	1,219,280	$792.53	1,524,100	$243.86
3/8"	7,558,500	831.44	684,290	444.79	855,360	136.86
1/4"	3,366,990	370.37	304,820	198.13	381,020	60.96
1/8"	824,570	90.70	74,650	48.52	93,310	14.93
1/16"	213,000	23.43	19,280	12.53	24,110	3.86
1/32"	52,910	5.82	4,790	3.11	5,990	.96

Enlarged copies of chart are available on request

ESTABLISHED 1862
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cial racks or boxes should be provided for all tools and material and they must be kept at these places when not in use.

▼ **Disposal of waste.** Dirty rags, car placards, oily rags, and paper should be collected daily and put into metal containers. Many loaders have the bad habit of using tank car bolsters as a junk bin. This has caused several serious fires.

▼ **Smoking.** The danger of smoking around a loading rack is obvious. Loaders should refrain from even carrying matches. It is far better for the loader to leave his smokes and matches at the office or at home and avoid all suspicion should a fire occur.

▼ **Fire protection.** Each rack should have at least two means of rapid exit by stairs or ladder-ways.

At least three fire extinguishers of the proper type should be at the rack, one at each end of the rack and another on the ground level near a ladder or walkway up the rack. Each loader must be familiar with this equipment and know what to do in case of a fire. He must know that the loading spout must not be jerked out of a burning dome as this would spread the fire. Tank dome fires are usually smothered by throwing a wet burlap bag over the dome. Remote shut-off valves should be closed promptly before fighting a spreading fire. The best practice is to eliminate the cause of fires and there will be no fires to fight.

Finally, the carloader should know that all injuries, however small, require first aid attention. He should know how to give artificial respiration to persons overcome by gasoline vapors and always explain dangers and hazards that exist to his fellow workers.

In cases of doubt, the carloader should make no decision without consulting his foreman or superintendent. He should always report conditions or hazards that require attention or repairs. His job is not to expose his life needlessly, rather it is to safely perform a task that by nature is risky. Gasoline is a great factor in the progress of the world and a mighty servant, but it is a powerful enemy in the hands of the ignorant and inexperienced.

These safe practices cannot cover every loading rack nor the conditions under which they operate, but the fundamental theory of safety to life and limb and the protection of property is incorporated in each of them.

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★ ★ ★

THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 87

A VALUABLE and regular feature of *The Petroleum Engineer*, the Continuous Tables, now in their seventh year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer*. Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have developed as a result of suggestions for new tables, direct contributions, and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue, 73-79, inclusive, in the January, 1944, issue, 80-82, inclusive, in the April, 1944, issue, and 83-85, inclusive, in the July, 1944, issue.

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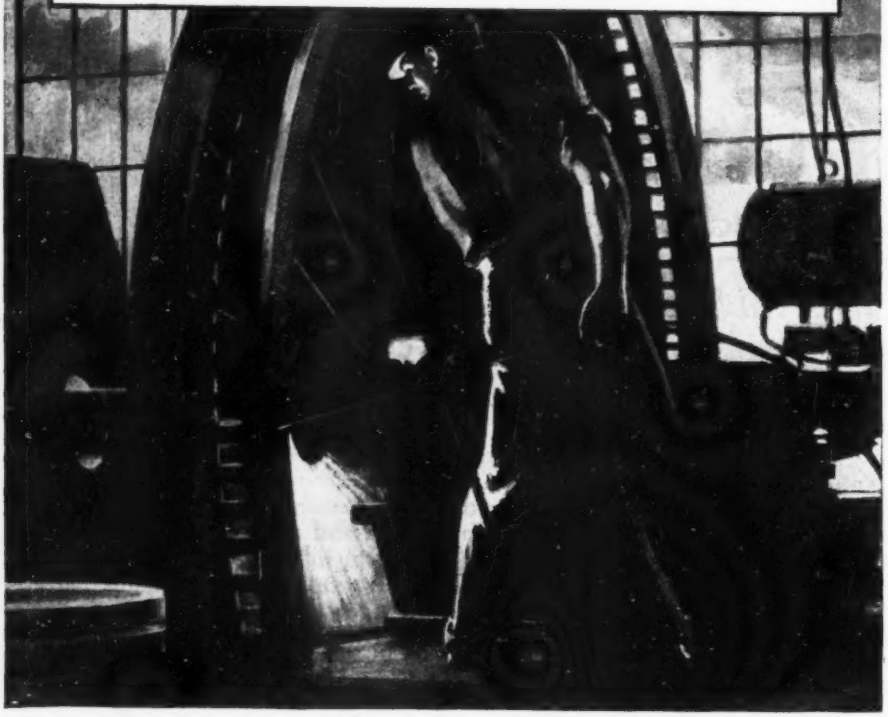
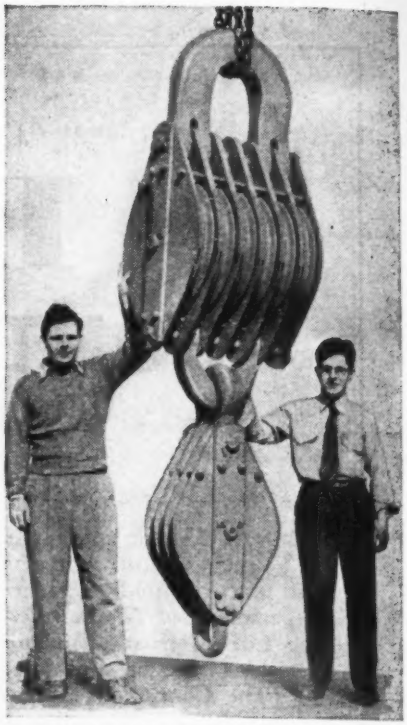
Nash Engineering Co. (Sheet 4)	212	Sept.	P 625.000.

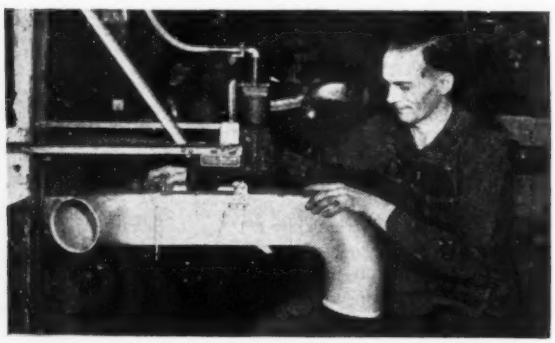
IN THE NEWS
WITH TORRINGTON BEARINGS

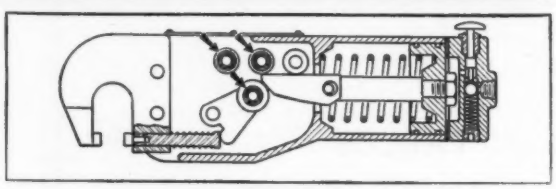


ALL IN THE DAY'S WORK typifies the attitude of Torrington engineers when they undertake the design and manufacture of anti-friction bearings for new or unusual applications. The skilled workman shown in the illustration is grinding the race for a precision bearing 10 feet in diameter, with a tolerance of two-thousandths of an inch. When you need counsel on standard or large, custom-built bearings, TURN TO TORRINGTON.

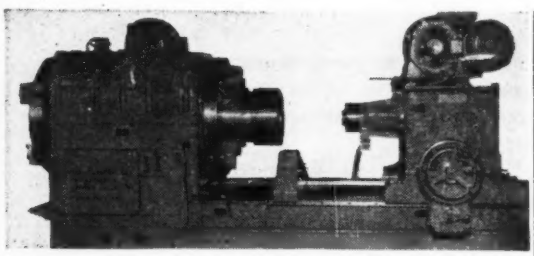


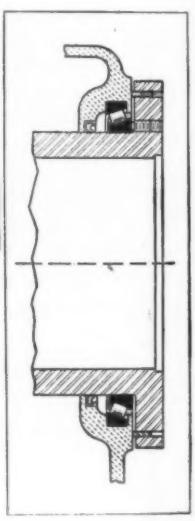
LIFTING 125-TON LOADS is the job of these tackle blocks designed and built by the Downs Crane & Hoist Company. With one block employing six sheaves, the other three, they are used in tandem to reeve the 19 parts of one inch wire rope required to sustain the load. Two NCS Needle Bearings, supplied by Torrington's Bantam Bearings Division, were installed in each of the sheaves which revolve on a 3" hardened and ground shaft, with the pin hollow bored for pressure lubrication. NCS Needle Bearings combine the advantage of high load capacity and compact design with ease of installation.





THIS CINCINNATI PNEUMATIC Squeeze Type Riveter, with a 3-ton compressive force, manufactured by the Schauer Machine Company, provides an interesting application for Torrington LN Needle Bearings. Selected because of their compact design and high load capacity, the bearings were installed, as shown in the accompanying cross-section, at the points where pressure is extremely high.





MILLING THREADS in 8" howitzers and 155 mm. guns is part of the important work performed by this Master Thread Miller, manufactured by the Smalley-General Company. To provide the essential accuracy at high speeds, and to take up the very heavy radial and thrust loads, both main and milling spindles are mounted in Tapered Roller Bearings, 30" O.D., as shown in the accompanying cross-section. Eccentricity and face run-out of these bearings is .0005 maximum—an example of the ability of Torrington's Bantam Bearings Division to build precision bearings for heavy-duty applications.

ARMY E NAVY

TORRINGTON BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

THE TORRINGTON COMPANY • BANTAM BEARINGS DIVISION

SOUTH BEND 21, INDIANA

ALIGNMENT CHARTS FOR PIPELINE OPERATIONS

By W. D. PARKES, *United Gas Pipe Line Company*

THE modern industrial trend is towards a more liberal application of mathematics to industry. The natural gas industry has been a leader in this field. This article is designed to be a practical guide to the practical pipe line foreman in applying to his daily work the mathematical equations developed by the engineers and technicians of the industry. Some of the calculations are simple, others are complex; some recur frequently, others but seldom; some require skill on the part of the computer, others do not. Their recurring solution, however, is a necessary, and in any event, a time consuming function.

The alignment chart is a device that minimizes the time required to solve recurring equations and eliminates practically all the mathematical work involved in a normal solution. They are called alignment charts because their key is the alignment of three points. The chart appears in a series of scaled lines, one such scaled line for each variable in the equation. When more than three variables exist, the chart also contains pivot or turning scales. In most cases these scales are not calibrated.

Three fundamental advantages are offered by the alignment chart: it eliminates all mistakes that are apt to creep in with long-hand computations, it saves time, and it permits the use of practical men in place of highly trained technicians or engineers on routine test or control work. Any of these advantages warrants the use of an alignment chart.

Mistakes frequently occur in even the most simple long-hand computation. There are only two kinds of mistakes that may occur in using alignment charts: the user may misread the values on the scale or his straight edge may slip during the manipulation involved in the solution, however, this still eliminates all possible mistakes due to arithmetic, whether multiplying, raising to a power, taking a root, or carrying out any other mathematical procedure.

A second advantage of alignment charts is that their use saves time. The solution of even a very simple equation requires time. This problem of time becomes even more important when equations increase in their complexity.

The third important advantage of alignment charts is that they enable the practical man to take the place of the engineer or technician when the operation requires the solution of recurring equations.

SHEET 3

It should be remembered when using the charts that all scales are to be used in groups of three, and only as given in the key on the chart. If the chart for Calculating Pipe Line Storage Capacity, sheet 3, is to be solved in the order given in the key, the first step would be to apply a straight edge to the known values on D and L, and a value will be obtained on X. This scale is not calibrated so the intersection of the line from D to L should be marked lightly with a pencil. If a value is shown on a turning scale it should be carefully noted, or preferably jotted down on a piece of scratch paper. Now the triad XVP may be solved by going from X to P and obtaining the point when the line crosses V. Study the example shown on the chart by dotted lines. It is possible, however, to obtain any one of the values D, V, L, or P if all of the others are known.

Problem: 1. It is desired to store 200 M cu. ft. in a 3-mile section of 10-in. O.D. pipe. What pressure will be required to store this volume of gas?

Solution: Draw a line from 10 in. O.D. on scale D to 3 miles on scale L. From the intersection of this line on scale X draw another line to 200 M cu. ft. on scale V and extend to the P scale. Read 330 lb. per sq. in., pressure required to store 200 M cu. ft. of gas in a 3-mile section of 10-in. O.D. line.

Problems: (a) What is the storage capacity of one mile of 6-in. O.D. line if the pressure on the section is 400 lb. per sq. in. gauge? (b) What gas volume will be left in the section if sufficient gas has been used to lower the pressure to 100 lb. per sq. in.? (c) What gas volume was used during this period?

Solution: (a) Draw a line from 6 in. on the left hand side of scale D to 1 mile on scale L. From the intersection of this line on scale X draw another line to 400 lb. per sq. in. gauge on scale P. Read 28 M cu. ft. storage capacity of section at 400 lb. per sq. in. gauge. (b) Draw another line from the intersection on turning scale X to 100 lb. per sq. in. gauge on scale P. Read 7 M cu. ft., the volume of gas remaining in the section when the pressure has been reduced to 100 lb. per sq. in. gauge. (c) The volume of gas used during the time the pressure was being reduced from 400 lb. to 100 lb. is $28 - 7 = 21$ M cu. ft.

SHEET 4

The next chart is titled, "Chart for Calculating Gas Volume Lost Purging Line Through Open End," sheet 4. This chart solves a formula with five variables and consists of five calibrated scales and two turning scales. Note that scale L is also a turning scale.

Problem: In blowing 7 miles of 4-in. O.D. line through open end for 30 minutes with 155 lb. per sq. in. gauge pressure at upstream end of section, what volume of gas is lost in blowing the line?

Solution: Locate 4-in. on scale D. Connect 7 miles on scale L. From the intersection of this line on turning scale X draw a line to 155 lb. on scale P. Now from the intersection of this line on scale L draw another line to 30 minutes on scale T. Read 0.045 M^2 cu. ft. or 45 M cu. ft. on scale V. Note that the volume scale on this chart is calibrated in M^2 cu. ft.

Problem: Assuming that it will take 3,000 M cu. ft. ($3M^2$ cu. ft.) to purge 3 miles of 16-in. line with 190-lb. upstream, how much time will be required to

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ALIGNMENT CHARTS FOR PIPELINE OPERATIONS

purge the line? (Note: This problem although not practical is included to show that any variable may be obtained if all the others are known.)

Solution: Draw a line from 16-in. on scale D to 3 miles on scale L. From the intersection of this line with scale X draw another line to 190-lb. on scale P. Note that this line crosses scale L. at 0.95. Extend a line from 0.95 on L through 3 M^2 cu. ft. on scale V and on until it intersects scale T. Read 30 minutes on scale T, time required to purge line.

SHEET 5

The next chart is for "Calculating Gas Volume Lost in Purging Line Through Standard Blow-off," sheet 5. This chart is used frequently to determine the time necessary to drain a section of line through a standard size blow-off.

Problem: In purging 2 miles of 14-inch line through 3-in. blow-off for 20 minutes with 250 lb. per sq. in. gauge pressure, what volume of gas is lost in purging?

Solution: Locate 14 on scale D. Connect to 2 miles on scale L. Read 26 on coefficient scale C. Transfer value of C to C′ scale. Draw a line from 26 on C′ scale to 3-in. blowoff. Parallel to this line draw another line from 250 lb. per sq. in. on scale P until it intersects scale X′ and read 59.5. Transfer this value to the X scale and draw a line to 26 on C. From the intersection of this line on the turning scale Z draw a line to 20 minutes on scale T. Read 510 M cu. ft. on scale V, gas lost in purging.

Problem: It is necessary to drain 10 miles of 18-in. main line through a 4-in. blow-off. The pressure on the line when it was closed in was 200 lb. per sq. in. gauge. How long will it take to drain the line? Note: As the pressure will decline from 200 lb. per sq. in. gauge to 0 it is assumed that the mean pressure is the average pressure, i.e.,

$$\frac{200 - 0}{2} = 100 \text{ lb. per sq. in. ga.}$$

Solution: First determine the storage capacity of the section from chart on sheet 3, which is 1,150 M cu. ft. The value of the coefficient is obtained by drawing a line from 18 on D to 10 on L. Read 23 on C and transfer to C′. Draw a line from 23 on C′ to 4-in. on B. Parallel to this line draw a line beginning at 100 lb. per sq. in. gauge on P until it crosses X′ and read 58. Locate 58 on X and connect it to 23 on C. From the intersection of this line on Z draw a line through 1,150 M cu. ft. on V and extend it until it crosses T. Read 51 minutes on T, time required to drain the 10-mile section.

Leakage of gas from pipe lines is a very serious matter. A well constructed modern line is said to be tight, but even such a line will probably allow a small leakage. Before new lines are put in service, and in many cases after a line has been used for a period of years shut in pressure drop tests are conducted in order to measure the gas lost from them. Leakage is generally proportional to the absolute pressure and the area of the inside of the pipe. This is true in nearly all cases where leakage is due to corrosion or to faulty joints. It would not be true in cases of split pipe, but such cases are not included under leakage, since a break in a pipe results in a blow out which is usually discovered very quickly.

The United States Bureau of Mines in cooperation with the Natural Gas Department of the American Gas Association made very extensive studies of various lines throughout the United States. From these studies they have recommended that a line be considered tight if the leakage does not exceed 50 M cu. ft. per year per mile of 3.068-in. I.D. pipe at 100 lb. per sq. in. absolute.

SHEET 6

Sheet 6, titled "Chart for Pipe Line Leakage Test," is to be used when shut in pressure drop tests are run.

Problem: A new section of 16-in. line has been shut in for a leakage test. From the following observations will the line be accepted by the pipe line department?

	Ga. press., lb.	Temp., °F.
First set of Observations	150	61
Second set of Observations	147	64

Time required for pressure drop 24 hours.
Diameter of pipe 16-in.

Solution: First obtain the pressure drop during the test (150 — 147 = 3 lb. per sq. in.). The pressure drop is corrected for change in temperature by adding the equivalent pressure for A + 3° F. change at 150 lb. per sq. in. (see table) to the pressure drop (3 + 0.9 = 3.9 lb. per sq. in.). Now locate the pressure drop during the test corrected for temperature i.e., 3.9 lb. per sq. in. on scale DP and connect it to 16-in. on scale D. From the intersection of this line on turning scale X draw another line to 297 lb. per sq. in. on scale P_s (150 + 147 = 297) the intersection of this line on turning scale Z is then connected to 24 on scale T. Read 82 M cu. ft. a year per mile of 3.068-in. I.D. pipe at 100 lb. per sq. in. absolute on scale L. The section will not be accepted since the leakage exceeds 50 M cu. ft. per year per mile of 3.068-in. I.D. pipe at 100 lb. per sq. in. absolute.

SHEET 7

The "chart to correct Gas Volumes for Gravity and Temperature" requires no explanation. Use of the chart is made clear by the example below it.

The most satisfactory straight edge for use with alignment charts is a heavy celluloid with a straight line scratched on the under side and filled with ink.

Those who wish to look into the theory and practice of nomography more intensively may find some reference in current magazines and books. Among the books may be mentioned:

"The design of Diagrams for Engineering Formulas," by Hewes and Seward, McGraw-Hill Publishing Co.

"Graphical and Mechanical Computation," by Joseph Lipka, Vol. 1, John Wiley & Sons.

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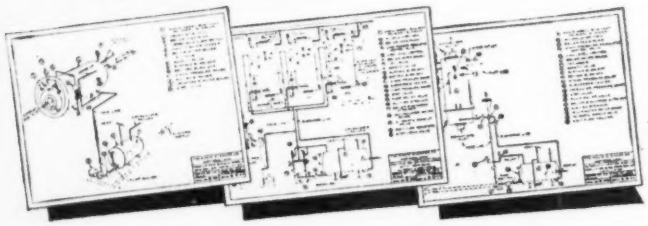
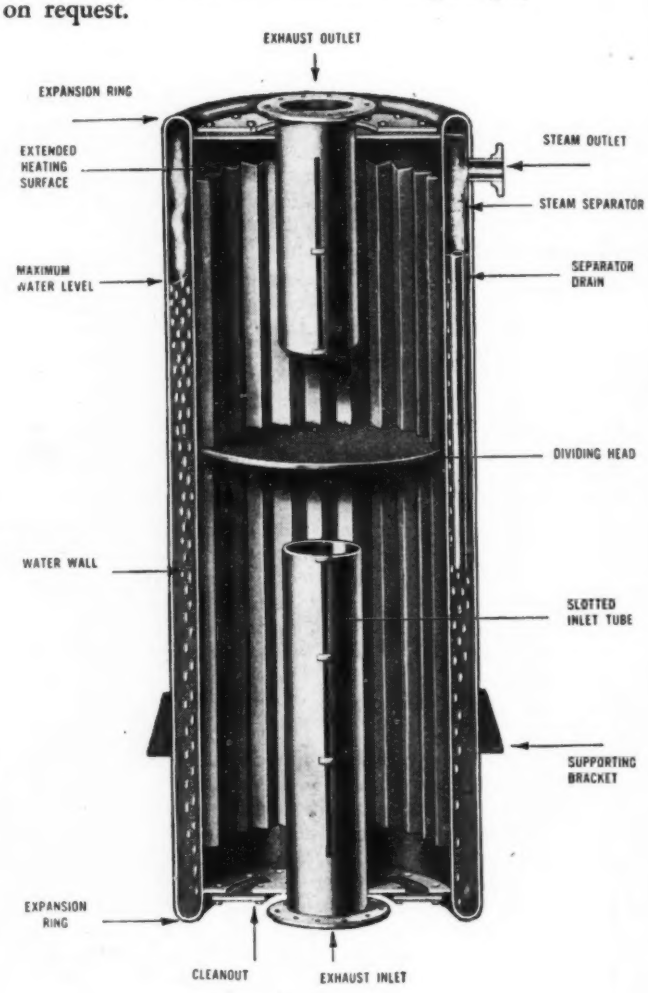
TYPICAL HOOK-UPS



The Maxim Engineering Department has prepared several drawings of typical Heat Recovery Silencer hook-ups. These are available with a detailed discussion of each hook-up. We will be glad to send them to you. Simply ask for Dwgs. B-298, B-301, B-302 and B-303.

Why not present your specific problem to Maxim engineers? Descriptive Bulletins WH-100, WH-102 and WH-103 will be sent promptly on request.



THE MAXIM SILENCER CO.
90 Homestead Ave., Hartford, Conn.

ARMY E NAVY

MAXIM

CHART FOR CALCULATING PIPE LINE STORAGE CAPACITY

FORMULA

$V = 0.00193\ d^2\ L\ P$

Where:

V = volume in M. cu. ft. at 8 oz. 14.4 lb. per sq. in.,
d = inside diameter of pipe,
L = length of line in miles, and
P = pressure in line section lb. per sq. in. ga.

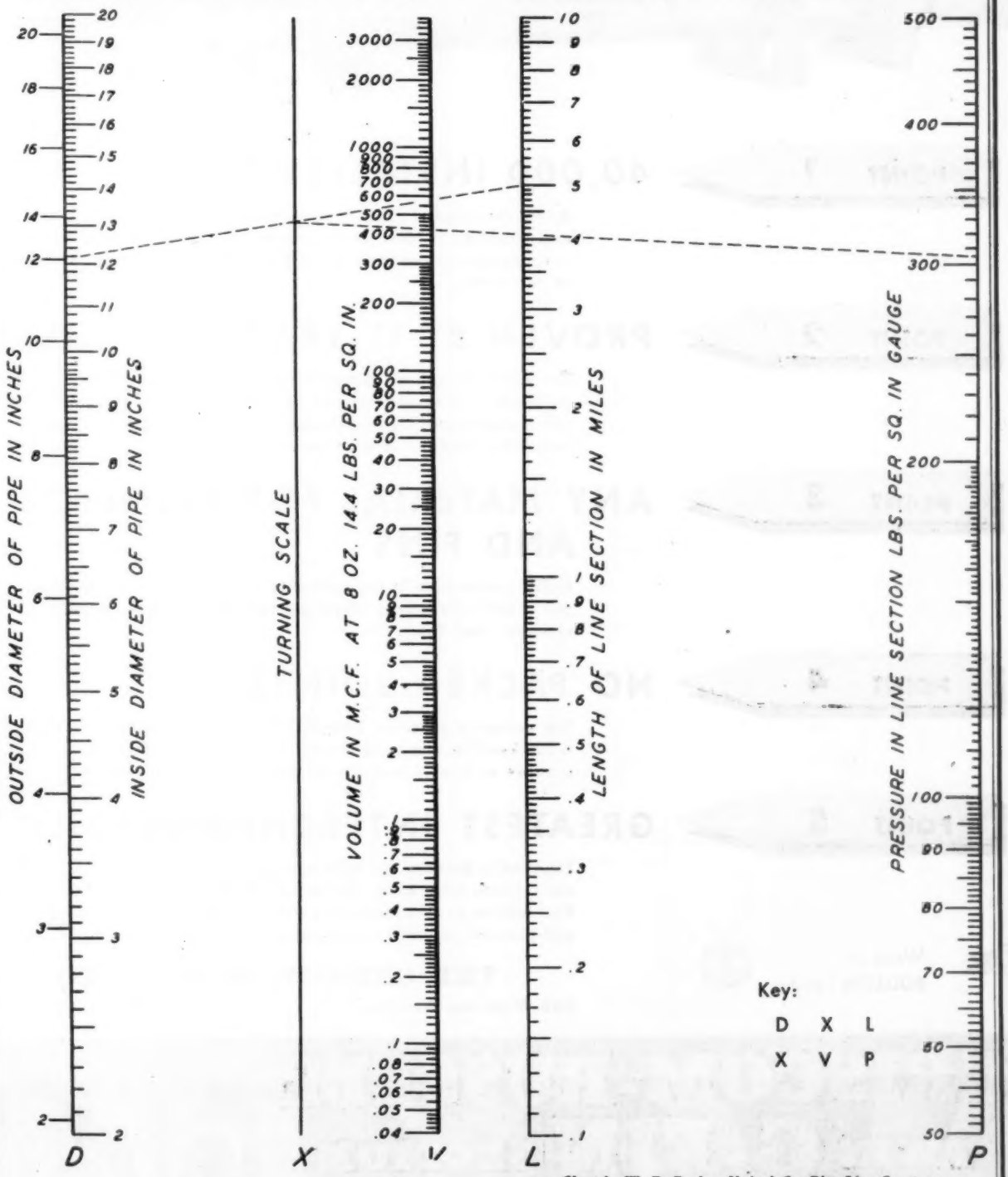
EXAMPLE

Problem:

Drain 5.0 miles of 12-in. I.D. line from 305 lb. per sq. in. ga. to atmospheric pressure.

Solution:

Locate 12 in. on scale D and connect to 5 miles on scale L. From the intersection of these lines on turning scale X, draw another line to 305 lb. on scale P. Read the answer 420 M. cu. ft. on scale V.



—Chart by W. D. Parkes, United Gas Pipe Line Company.

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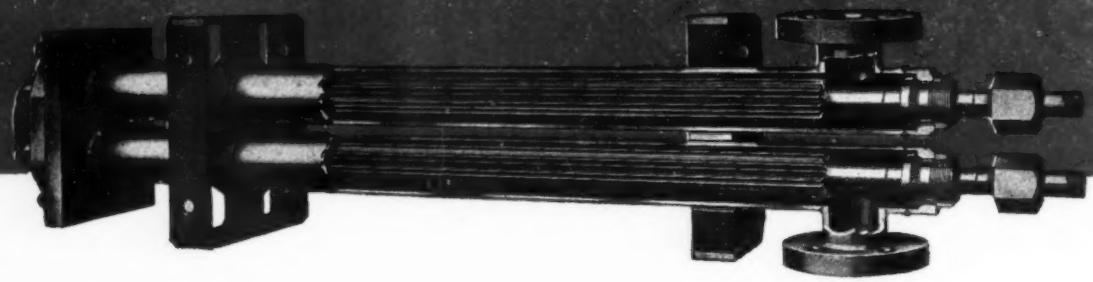

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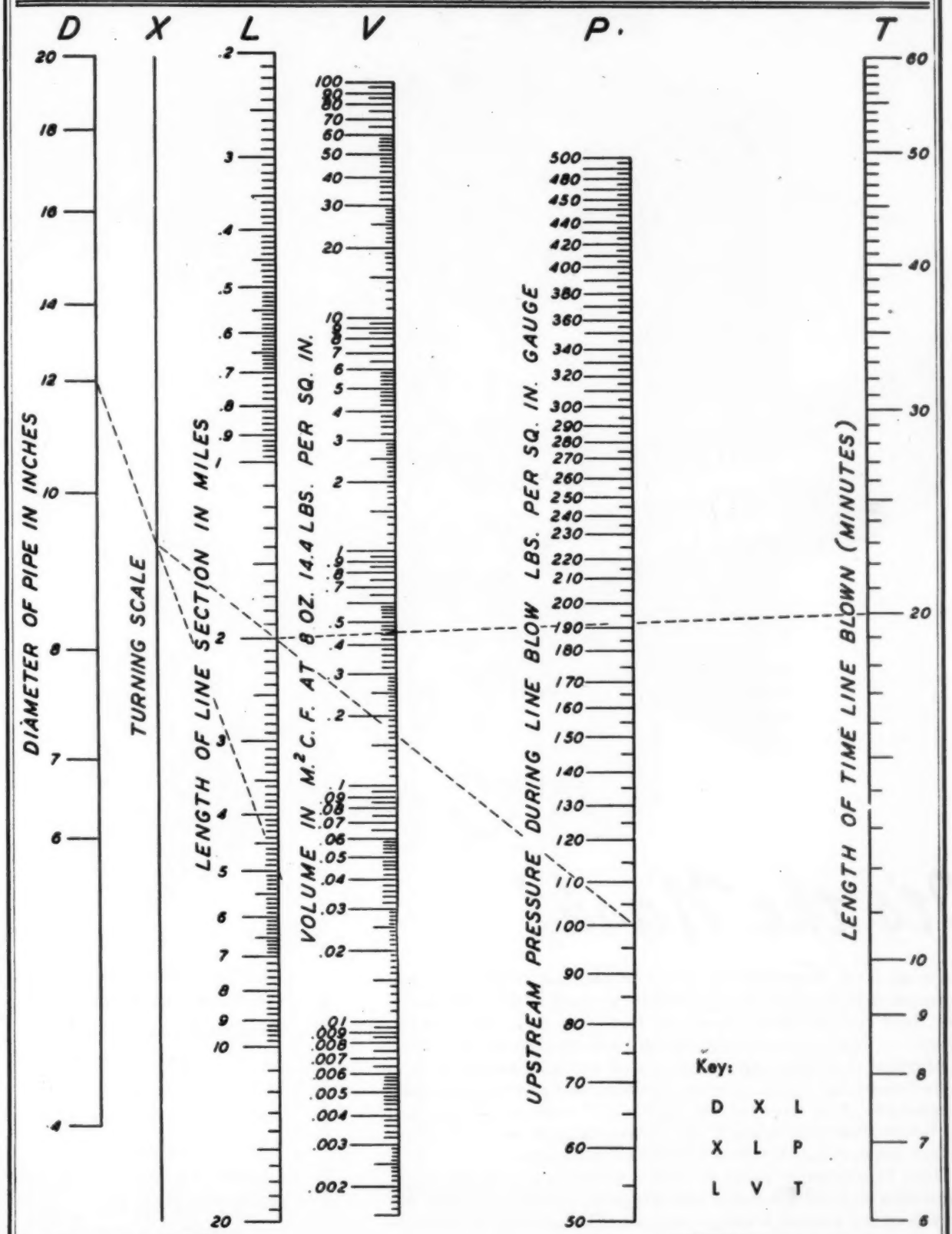
GRISCOM-RUSSELL TWIN G-FIN SECTION

The Universal Heat Exchanger

Chart for Calculating Gas Volume Lost in Purging Line Through Open End



Formula: $V = CT\sqrt{P^2 - 207}$

Where:

V = volume in M. cu. f. (8 oz. 14.4 lb. per sq. in.) discharged from line section with one end open to atmospheric pressure,

C = one hour Weymouth pipe line coefficient for section $\left(\frac{35.68\ d^{8/3}}{\sqrt{L}}\right)$,

T = length of time line blown (hours), and

P = upstream pressure during line blow (lb. per sq. in. abs.).

EXAMPLE

Problem: Purge 5 miles of 12 in. line through open end for 20 minutes with 100 lb. per sq. in. ga. pressure at upstream end of section. What volume of gas will be lost?

Solution: Locate 12 in. on scale D. Connect to 5 miles on scale L. From the intersection of this line on turning scale X, draw a line to 100 lb. on scale P. Now from the intersection of this line on scale L (a turning scale) draw another line to 20 minutes on scale T. Read 0.45 M² cu. ft. or 450 M. cu. ft. on scale V.

—Chart by W. D. Parkes, United Gas Pipe Line Company.

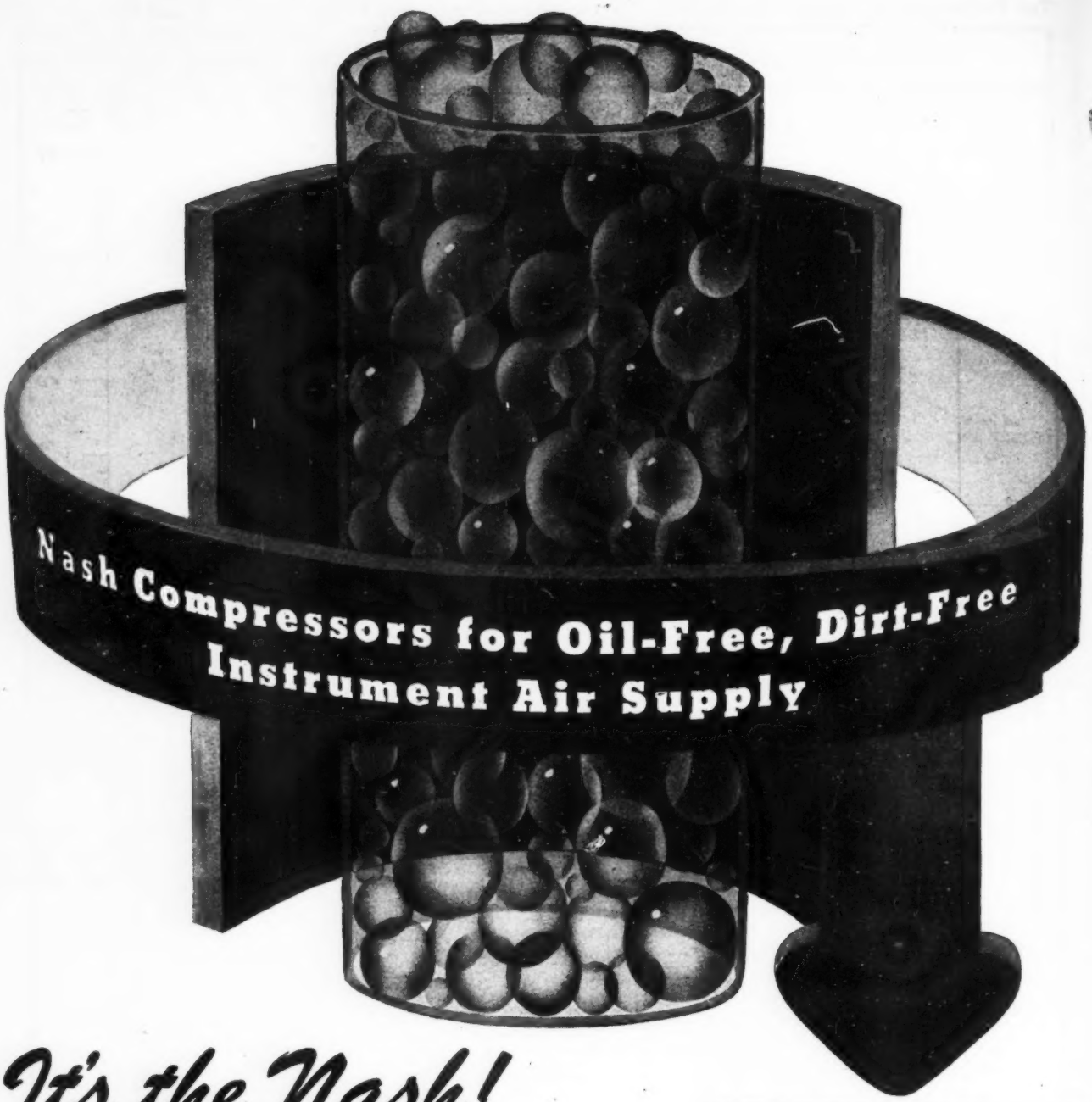


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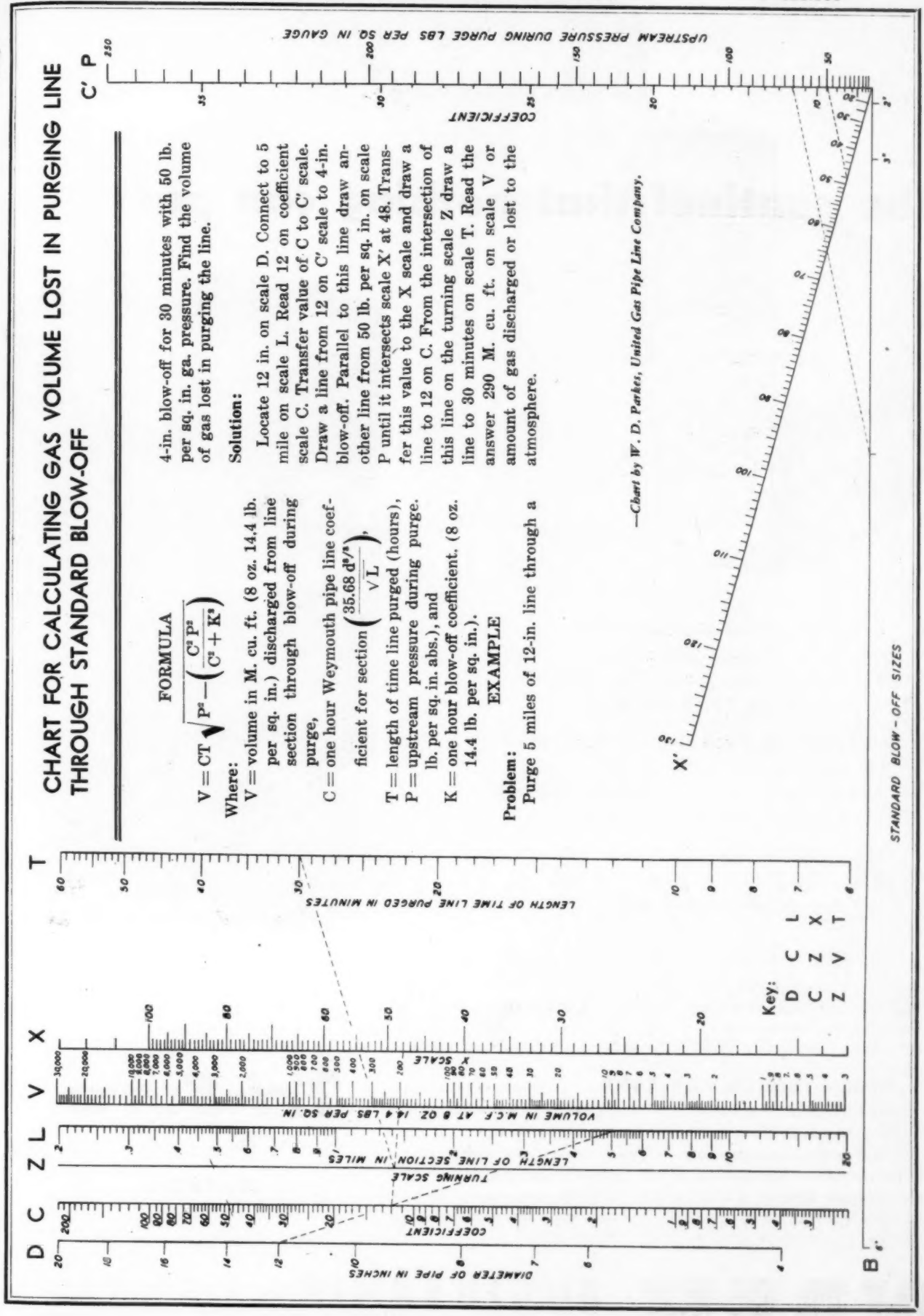
CHART FOR CALCULATING GAS VOLUME LOST IN PURGING LINE THROUGH STANDARD BLOW-OFF



FORMULA

$$V = CT\sqrt{P^2 - \left(\frac{C^2 P^2}{C^2 + K^2}\right)}$$

Where:

V = volume in M. cu. ft. (8 oz. 14.4 lb. per sq. in.) discharged from line section through blow-off during purge,

C = one hour Weymouth pipe line coefficient for section $\left(\frac{35.68\ d^{8/3}}{\sqrt{L}}\right)$,

T = length of time line purged (hours),

P = upstream pressure during purge. lb. per sq. in. abs.), and

K = one hour blow-off coefficient. (8 oz. 14.4 lb. per sq. in.).

EXAMPLE

Problem:

Purge 5 miles of 12-in. line through a 4-in. blow-off for 30 minutes with 50 lb. per sq. in. ga. pressure. Find the volume of gas lost in purging the line.

Solution:

Locate 12 in. on scale D. Connect to 5 mile on scale L. Read 12 on coefficient scale C. Transfer value of C to C' scale. Draw a line from 12 on C' scale to 4-in. blow-off. Parallel to this line draw another line from 50 lb. per sq. in. on scale P until it intersects scale X' at 48. Transfer this value to the X scale and draw a line to 12 on C. From the intersection of this line on the turning scale Z draw a line to 30 minutes on scale T. Read the answer 290 M. cu. ft. on scale V or amount of gas discharged or lost to the atmosphere.

The sentinel that nothing can pass

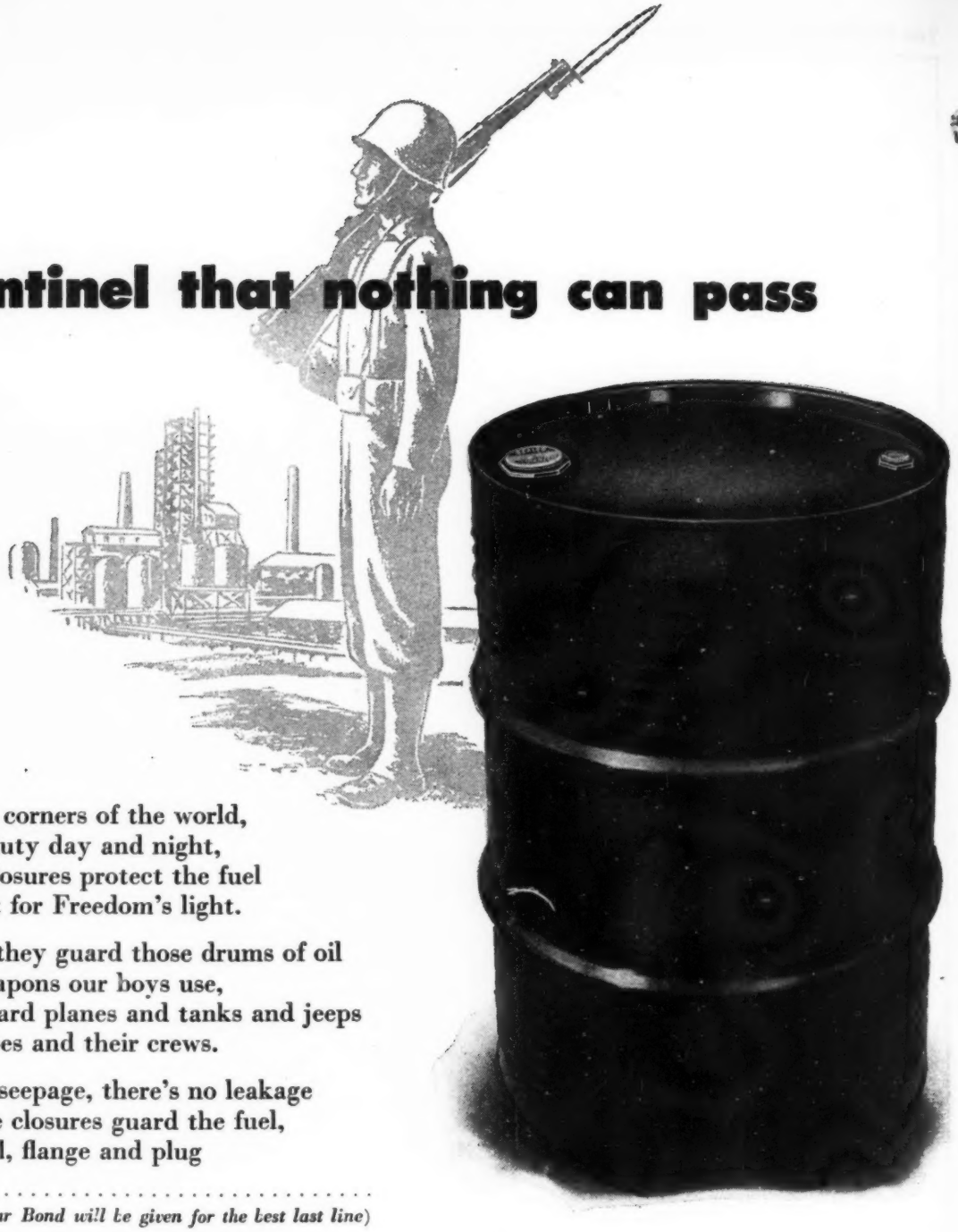


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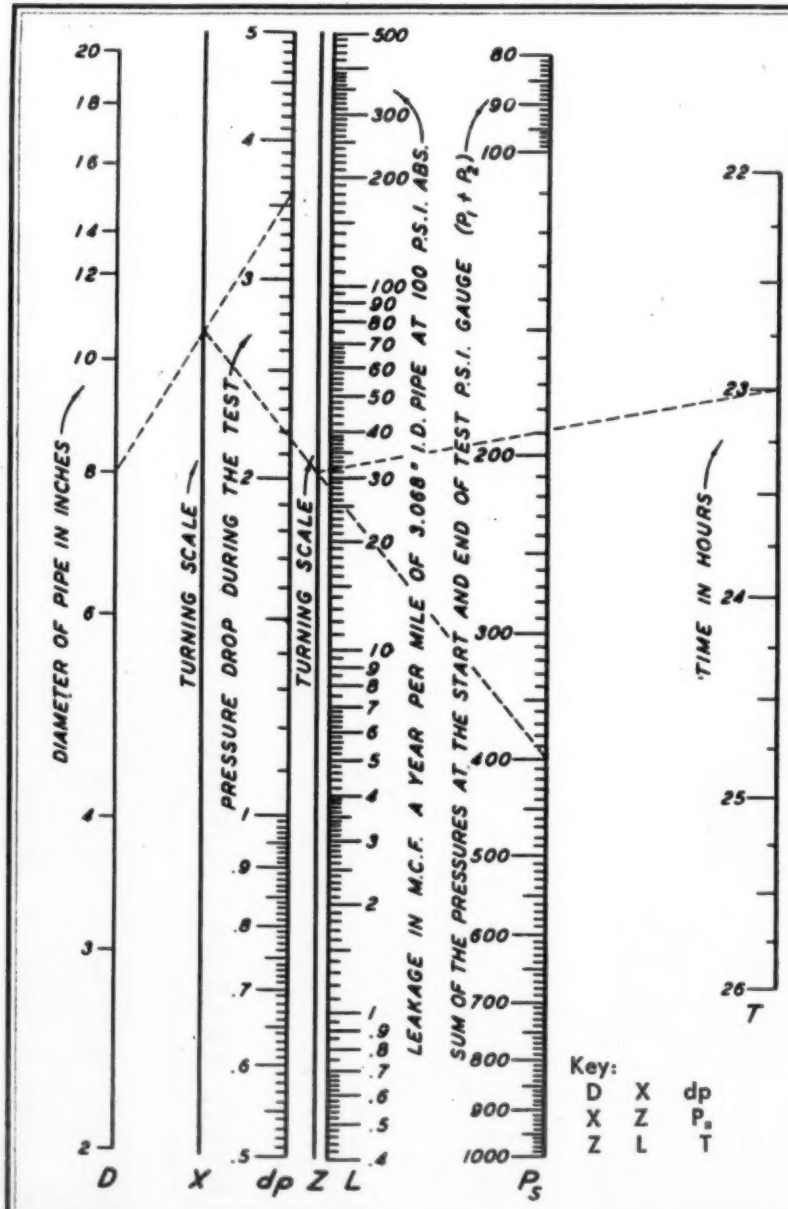
CHART FOR PIPELINE LEAKAGE TEST



Equation:

$$Y = \frac{10{,}750\ D\ (dp)}{P_s\ t}$$

Where:

Y = leakage in M. cu. ft. per year per mile of 3.068 in. I.D. pipe at 100 per sq. in. abs.,

D = internal diameter of pipe, in.,

dp = difference in pressures ($P_1 - P_2$) where P_1 is the absolute pressure in lb. per sq. in. at the start of the test, and P_2 is the absolute pressure in lb. per sq. in. at the end of the test (see table for temperature correction),

P_s = sum of the pressures, and

t = time in hours.

TABLE 1

Temperature correction

Line test pressure lb. per sq. in.	1° Fahrenheit equivalent to lb. per sq. in.
100	0.2
200	0.4
300	0.6
400	0.8
500	1.0
600	1.2
700	1.4
800	1.5
900	1.7
1000	1.9

If the temperature at the end of the test is higher or lower than the temperature at the start of the test, add or subtract the equivalent pressure to the pressure drop during the test.

EXAMPLE

Problem:

Find the leakage in M. cu. ft. per year per mile of 3.068 in. I.D. equivalent pipe at 100 lb. per sq. in. absolute.

Given:

10 miles of 8-in. O.D. pipe. The time required for pressure drop is 23 hours.

	Pressure lb. per sq. in.ga.	Temperature °F.
First set of observations	202	54
Second set of observations	198	53

Solution:

First obtain the pressure drop during the test (202 — 198 = 4 lb. per sq. in.). The pressure drop is corrected for change in temperature by subtracting the equivalent pressure for 1°F. change at 200 lb. per sq. in. (see table) from the pressure drop. (4 — 0.4 = 3.6 lb. per sq. in.)

Locate the pressure drop during the test corrected for temperature, i.e., 3.6 lb. per sq. in. on scale dp, and connect it to 8 in. on scale D. From the intersection of this line on the turning scale X, draw another line to 400 lb. per sq. in. on scale P_s. (202 + 198 = 400 lb. per sq. in.) The intersection of this line on turning scale Z is then connected to 23 on scale T. Read the answer 31.8 M. cu. ft. on scale L.

—Chart by W. D. Parkes, United Gas Pipe Line Company.

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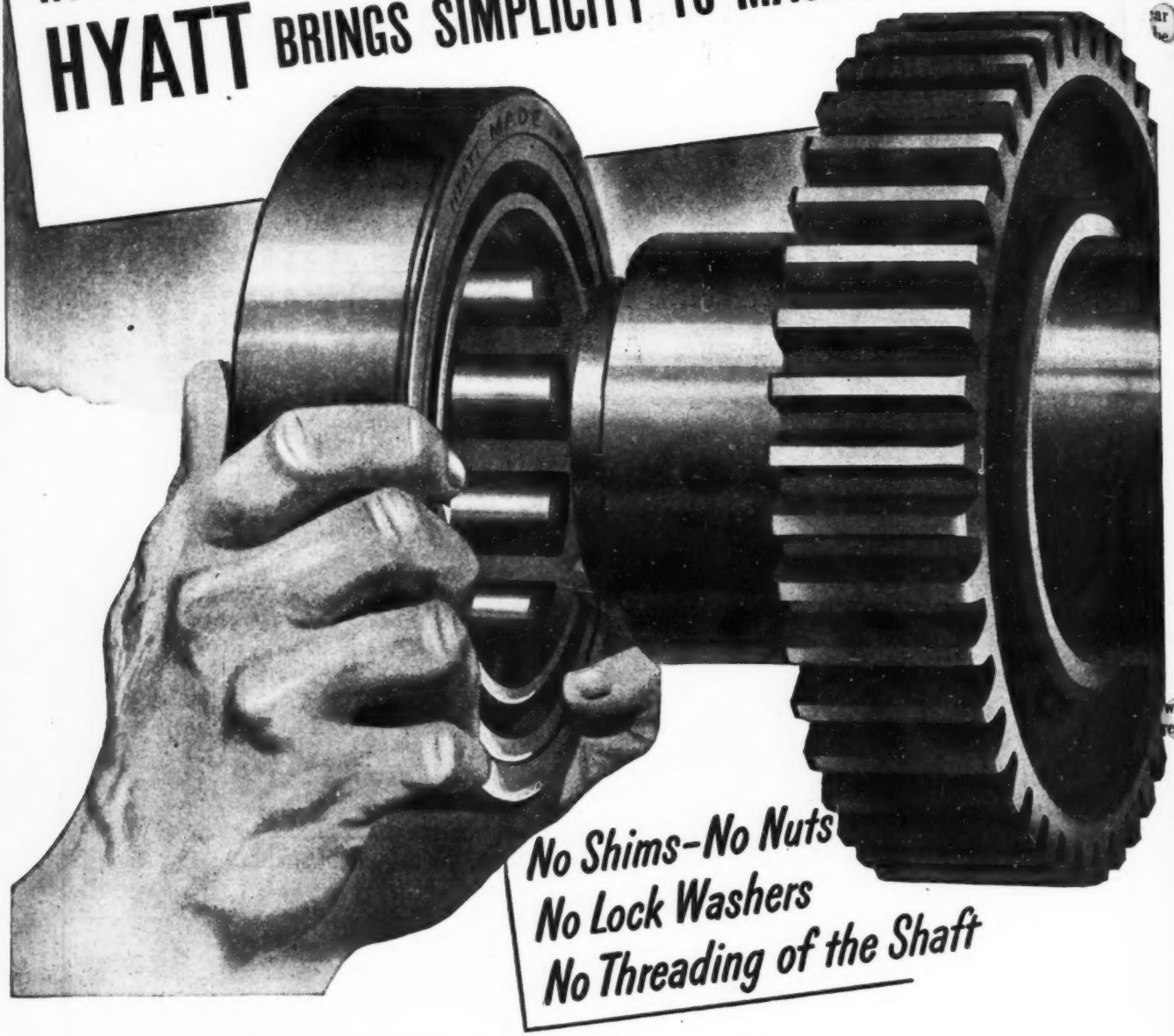

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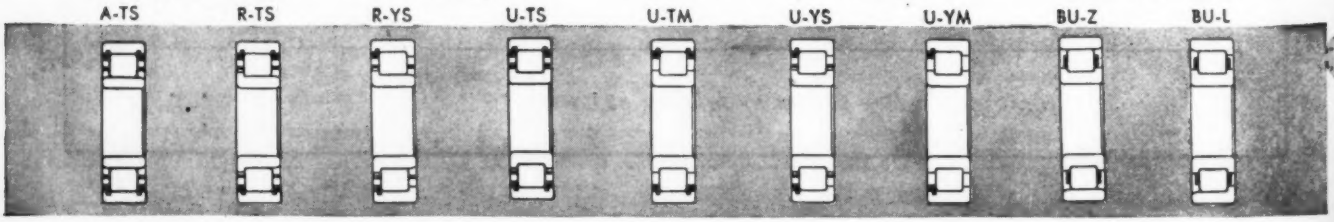
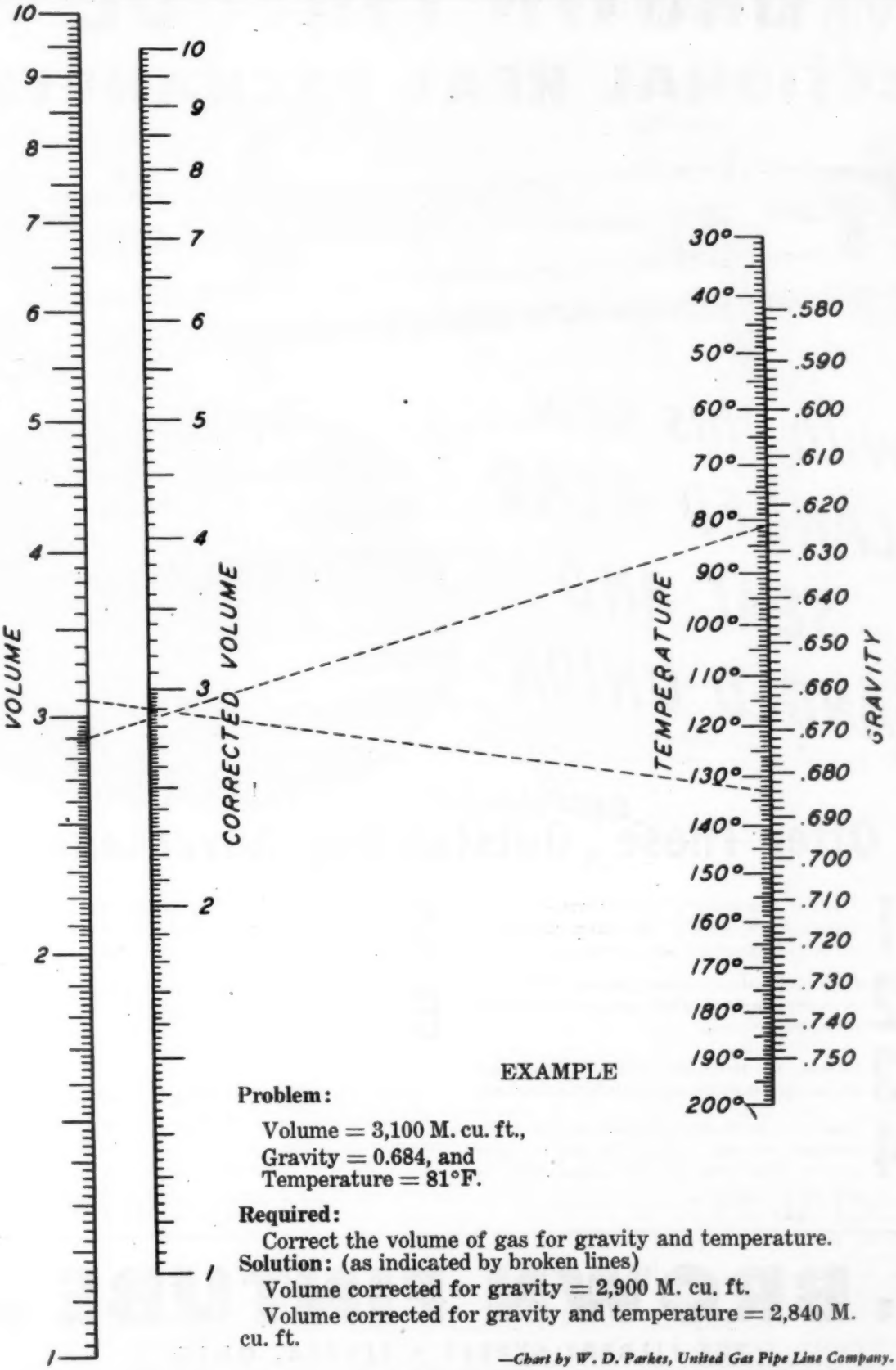


CHART TO CORRECT GAS VOLUMES FOR GRAVITY AND TEMPERATURE



EXAMPLE

Problem:

Volume = 3,100 M. cu. ft.,
Gravity = 0.684, and
Temperature = 81°F.

Required:

Correct the volume of gas for gravity and temperature.

Solution: (as indicated by broken lines)

Volume corrected for gravity = 2,900 M. cu. ft.

Volume corrected for gravity and temperature = 2,840 M. cu. ft.

—Chart by W. D. Parkes, United Gas Pipe Line Company.

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SEAL AND
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Running Tour WITH MEN IN THE INDUSTRY

▼ **R. C. (Claud) Johnston** has organized the Comet Drilling Company of Texas with operating headquarters in the Peoples National Bank Building, Tyler, Texas. Initial work of the new drilling company is in West Texas where Comet has two rigs running. Plans for expansion include drilling in East Texas and the Gulf Coast territory. Johnson joined Delta Drilling Company in 1932 and resigned the position of vice president and director of that company to establish his own company.

▼ **Harold F. Moses** has been elected a vice president of The Carter Oil Company and named head of exploration and research according to O. C. Schorp, president. Moses joined Carter as geologist in 1934 and since then has seen service as division geologist in the eastern division, assistant manager of exploration and chief geologist. He will relieve **John W. Brice,** executive vice president, enabling him to devote more time to other phases of the company's business.

▼ **P. P. (Pete) Gregory,** chairman of the Yates Field Engineering Committee, West Texas, has moved his headquarters from the field to Fort Worth.

▼ **C. D. (Chuck) Watson,** for the past two and a half years on special assignment for the Carter Oil Company in Washington, has returned to his administrative duties as director of the company, in charge of handling conservation matters with state regulatory bodies in Tulsa. Watson has been with Carter since 1916.

▼ **R. B. Curran,** assistant to O. C. Schorp, president of the Carter Oil Company, has been appointed assistant manager of the company's northwest division, with headquarters in Billings, Montana, effective September 15. In his new position Curran will assist Frank W. Bruner, manager of the northwest division.

▼ **L. J. Pundt,** Tulsa, sales manager of the S. M. Jones Company, manufacturers of sucker rods, announces the appointment of **Wm. M. Ware** as district representative with headquarters in Tulsa. Ware, formerly with the Texas Pipe Line Company, was previously connected with an industrial engineering firm in Chicago. He attended the University of Tennessee, Knoxville, studying electrical engineering.

Wm. M. Ware

▼ **W. Kendall Baker,** who for the past two and a half years has been with the legal department of the Shell Oil Company, has resigned his position. He will be associated with the law firm of Burris & Benton in Houston.

▼ **Omer L. Woodson** has resigned as vice president of Bell Aircraft Corporation and manager of its Georgia division to become vice president of the Hughes Tool Company, Houston, Texas, and manager of the company's aviation branch with headquarters in Los Angeles. He will work with Howard Hughes, head of the company.

▼ **Ray Pearson,** former Gulf Oil Corporation field auditor, has resigned to accept a position with the Bert Miller Drilling Company operating in the Illinois area.

▼ **Dr. G. S. Dille** is the newly appointed manager of the land and geological department of the Deep Rock Oil Corporation, according to H. N. Greis, president. Dr. Dille entered the oil business as geologist with The Texas Company, and remained with that company until 1936 when he entered business as consulting geologist. He is a member of the American Association of Petroleum Geologists, and the American Institute of Mining and Metallurgical Engineers.

▼ **H. C. Speer,** Seminole, oil and gas conservation officer of the corporation commission, died unexpectedly August 13 while on official business for the corporation. He was 54 years of age.

▼ **George Stuart Heyer,** president of the General Crude Oil Company since its organization, died August 14 while vacationing in Mexico City with his family. He was 52 years old.

▼ **C. W. Perelle** has resigned as vice president in charge of manufacturing of the Consolidated Vultee Aircraft Corporation to become an official of the Hughes Tool Company in Houston.

▼ **John Stewart** has been elected a director of the Deep Rock Oil Corporation to fill the vacancy caused by the death of John J. Skinners, H. N. Greis, president of the company, has announced. Stewart is president of the Donner Estates, Inc., Philadelphia.

▼ **R. M. Hurt,** former superintendent of the Pickens district of the Carter Oil Company, has been made district superintendent of the newly combined district offices at Pickens, Mississippi, and Jena, Louisiana. His headquarters will be in Vicksburg, Mississippi.

▼ **E. W. Austin,** assistant works manager in charge of tool engineering, has been appointed consulting engineer of the LaPlant-Choate. He has been with the company since 1934.

▼ **Forrest Medis,** field superintendent for the Ptak Oil Company, died at his home in Oklahoma City August 28. He had formerly been associated with the Magnolia Petroleum Company.

▼ **E. H. Dixon** and **N. C. McGowen** have been made presidents of Electric Power and Light Corporation and United Gas Corporation, respectively, following meetings of the board of directors held recently in New York. The new officers succeed J. H. Gill, deceased, formerly president of both companies. Vice president of United Gas is **R. H. Hargrove. A. B. Paterson** was named a director of both companies, while **W. T. Wynn** and **C. J. Savoie** were named directors for United Gas.

▼ **Captain G. A. Mabry** of the Humble Oil and Refining Company has been discharged from the army, and is now back at his old job in Houston, Texas.

▼ **Park J. Jones,** specialist in technical advisory services to producers of oil, condensate, gas and natural gasoline, has set up offices in Houston. A graduate of the University of California in 1931, he acquired his experience with The Texas Company on production in California, New Mexico, Texas, Louisiana, Oklahoma, and Illinois.

▼ **David R. Williams,** vice president of Williams Brothers Corporation, pipe line contractors, was seriously injured recently in an automobile accident while on a construction job outside the United States. The company has been engaged in work for the government, chiefly the navy, and was awarded the Army-Navy "E" for excellence of performance on a job outside the U. S.

▼ **William G. (Bill) Corey,** formerly sales manager for the Western Gear Works, California division, and the Pacific Gear Works, announces the opening of an office at 973 North Main Street, Los Angeles, California. This office, in association with the Lacy Oil Tool Company, will be devoted to the development and sales of oil field production equipment, particularly the air balanced pumping unit. He also will continue with special work for Western Gear Works. Corey was graduated from the University of California in 1920 as a mechanical engineer. From that time until 1926 he was assistant chief engineer for the Pacific Oil Company, San Francisco.

W. G. Corey

▼ **C. F. Speary,** president of The Link Oil Company, died August 21 following an operation. He had been in poor health for several years. He was a pioneer oil and gas producer and operated extensively in Ohio and West Virginia before joining the Link Company in Tulsa, Oklahoma.

▼ **Don C. Bothwell,** former vice president of Darby Petroleum Corporation, is president of the new Darby and Bothwell, Inc., formed by the merging of Darby Petroleum and the Sunray Oil Corporation. **J. F. Darby** is a stockholder. **Edward A. Koester,** district geologist of Darby in Kansas, is vice president of the newly formed company. **F. T. Anderson,** head of the Darby accounting department, is secretary-treasurer. Directors of the new company are Darby, Bothwell, Koester, Anderson, and **Rodney A. Bothwell,** former head of the land department in Kansas for Darby Petroleum. Offices for the company will be in Tulsa, Oklahoma.

▼ **Frank C. Abbot,** assistant tax commissioner of The Texas Company, died August 20 from a heart attack. He was assistant tax commissioner of Sinclair Oil Company in Texas for four years, but had been with The Texas Company since 1921.

▼ **Fred H. Warren,** after nine months with the Petroleum Administration for War in Washington, has returned to Ohio Oil Company to assume new duties as general superintendent of trunk and gathering lines east of the Mississippi, pipe line department. He has been assistant chief engineer in the pipe line department of Ohio Oil since June 1939.

▼ **R. L. Clifton** was named manager of the production department of Carter Oil Company following six months at that post in an acting capacity, according to O. C. Schorp, president. He has been with Carter since 1917 and until last March had been general

production superintendent for eight years. **M. A. "Mike" Wright,** former chief engineer of the company, has been appointed assistant production manager, and **Ralph E. Damp** has been confirmed as general production superintendent. Succeeding Wright as chief engineer is **Carl G. Herrington,** former division engineer and assistant division superintendent of the Carter's Central Division at Seminole. **W. E. Leroux** has been appointed division engineer of the Central Division.

▼ **Brown L. Meece** has been appointed vice president of Globe Oil and Refining Company of Illinois. He has been associated with Globe since 1932 and was advanced from sales manager of the company to his present position.

▼ **Winfield Givens** has been appointed to head a new Land Department recently established at the Philadelphia offices of Sun Oil Company. Givens joined Sun in Texas in 1920. After serving as district engineer in the Dallas area he was sent to Venezuela as chief engineer when Sun Oil Company became active there; and was later manager for Sun at Caracas. In 1931 he went to the Philadelphia office in the Production Department. He continued in that work until his recent promotion to head the new Land Department.

▼ **W. M. Stirtz,** formerly development geologist with Cities Service Oil Company, Bartlesville, has accepted a position with the geological staff of the Kerlyn Oil Company, Oklahoma City.

▼ **E. Floyd Miller,** chief geologist for A. G. Oliphant and his interests has moved his office back to Tulsa. He has been at Shreveport and San Antonio for the past three years.

▼ **Dr. Gustav Egloff,** Universal Oil Products Company, has been elected a director of the Chicago Technical Societies Council, representing 40 scientific and technical organizations in the Chicago area, with a membership of 15,000. He has also been elected a trustee of the Western Society of Engineers, which is one of the organizations represented in the Chicago Technical Societies Council.

▼ **W. J. (Bill) Nutto** recently resigned as sales manager of the Reed Roller Bit Company to assume the duties of sales manager of the Hunt Tool Company, of Houston, Texas.

W. J. Nutto

Nutto, after receiving his degree in mechanical engineering in 1922, spent 7 years in engineering and sales of mining machines and other pneumatic equipment before entering the oil industry as Mid-Continent manager of the oil tool division of Chicago Pneumatic Tool Company. He joined Reed Roller Bit Company in 1933 and, after a year in Oklahoma, spent several years covering South American and Mexican fields. Then followed 2 years' service as export manager in New York, after which he was moved to Houston to act as assistant sales manager. For the last 2½ years he has been general sales manager.

▼ Kobe, Incorporated has announced the recent consolidation of its Illinois, Kansas, and Tulsa districts into one district under the management of **M. L. Walraven, Jr.** Walraven is well known to the oil industry having been for a

M. L. Walraven, Jr.

E. T. Harrison

number of years manager of the company's Kansas district and more recently manager of the Tulsa district.

E. T. Harrison, formerly manager of the Illinois district, has been transferred to Tulsa and will assist Walraven in district matters as well as being in charge of the company's local activities.

Walraven and Harrison will retain their headquarters at 506 Kennedy Building, Tulsa.

▼ **T. Francis (Frank) Salthouse,** a draftsman in the production department of the Carter Oil Company since October 1915, retired September 1. He had been with Carter since 1915 when he entered the engineering department, later changed to the production department.

▼ **Ernest C. Breeding** has been elected comptroller of The Texas Company according to W. S. S. Rodgers, chairman of the board of the company. He succeeds **Ira McFarland,** who retired after serving as comptroller for 31 years. **R. G. Rankin** succeeds Breeding as assistant comptroller.

▼ **J. Howard Marshall,** chief counsel of the PAW and assistant deputy petroleum administrator, resigned September 1 to resume his law practice in San Francisco. Marshall had been engaged for extended periods in government service dealing with the petroleum industry. He entered government service in June, 1941, as a member of the Office of Petroleum Coordinator, and remained after it was changed to PAW.

▼ **W. D. Baskett, Jr.,** has been appointed executive secretary of the joint barge subcommittee for Districts 1, 2, and 3 of the petroleum industry committee organization. On leave from Allied Oil Company, Inc., of Cleveland, Baskett will also continue as executive secretary for the joint Great Lakes-New York state barge canal subcommittee for Districts 1 and 2. **L. T. Weger** will act as executive secretary of the refining committee for District 2 until a permanent appointment is made. He was lent to the committees by Ohio Oil Company. He is, in addition to his new duties, vice chairman of the crude oil supply subcommittee of the general committee for District 2. Formerly holding both assignments was **John D. King,** resigned to become counsel for the marketing division of Cities Service Oil Company, headquarters in Chicago.

▼ **W. H. Newman** of Philadelphia has recently been appointed as executive officer of PAW, and will head what was formerly two divisions of the administration. He is responsible for policies on personnel, budgets, and other internal operating matters, and will also continue to direct the work of PAW's organization and planning staff. Newman has been associate professor of business at Miami University, Oxford, Ohio, and a consultant in management and business to Marshall Field and Company, Chicago, and the Federal Reserve Bank of Philadelphia.

▼ **E. E. (Ned) Robbins** has accepted a position as world-wide oil representative with the United States Steel Export Company, a subsidiary of U. S. Steel Corporation. Robbins, who recently resigned as a liaison officer between WPB and PAW, may leave late this month for South America. He will be accompanied to Colombia, Trinidad, and Venezuela by **J. B. Graham,** assistant general manager of sales for the National Tube Company of Pittsburgh, another U. S. Steel subsidiary. Robbins is undertaking a 6-point job for U. S. Steel Export. They are: To keep his company informed on oil outside the country; to contact customers in distant lands; to answer sales questions; to further international relations; to visit distant lands; and to act in a public relation manner.

▼ **Robert E. Hardwicke,** oil attorney of Fort Worth, has been named chief counsel of PAW, Ralph K. Davies, deputy administrator, has announced. Hardwicke had been associate chief counsel since November, 1943.

▼ **H. B. Fuqua** was promoted from chief geologist of the Gulf Oil Corporation in the Fort Worth district to assistant to J. H. Russell, vice president in charge of production on September 6. Fuqua joined Gulf as geologist at Wichita Falls in 1922.

▼ **Norval F. Myers,** assistant manager of Standard Oil Development Company's process division, has been made manager to succeed **Paul E. Kuhl,** resigned to become assistant manager of the Baltimore and Charleston refineries of Standard Oil Company of New Jersey.

▼ **John H. Loudon,** assistant general manager of Caribbean Petroleum Company, Caracas, Venezuela, has been promoted to general manager. He succeeds **B. Theodore W. van Hasselt,** recently elected a managing director of the Royal Dutch Shell Group. Loudon has been with The Royal Dutch Shell group since 1930. He was formerly with Shell Oil Company of California.

▼ **H. S. Chase** and **Drew L. Hines** have been appointed vice presidents of Tide Water Associated Oil Company and **Richmond K. Kelly** has been appointed assistant vice president, according to an announcement by William E. Humphrey, president. Chase has had more than 22 years of service with the company in refining operations. He will continue in charge of manufacturing of the company's eastern division. Until early last year he was general superintendent of the company's refinery at Bayonne, N. J. Hines has had more than 21 years of service with the company in engineering, construction and transportation operations. He will continue in charge of transportation and supplies of the company's eastern division. Until last May he was assistant manager of transportation of the company's western division.

Kelly has had more than 15 years of service with the company in connection with its eastern division marine transportation operations. He will continue to have charge of the company's eastern division marine department.

▼ **Cyrus C. Robbins,** appraisal engineer for the Carter Oil Company, has resigned to enter the consulting field, specializing in reports, appraisals and tax studies with respect to petroleum and natural gas properties. He has been with Carter 10 years. He will establish an office in Tulsa, Oklahoma.

McCullough
COMBINATION GUN PERFORATOR and TESTER ADVANTAGES
Brown Line Print *No. 12*

TEST BOTH THE WATER SHUT-OFF AND THE FORMATION ON A SINGLE RUN WITH THE McCULLOUGH COMBINATION GUN PERFORATOR & TESTER

You do three jobs in one trip when you run a McCullough Combination Gun Perforator and Tester:

1—You first get a test of the cement or squeeze job.

2—Next you perforate the casing in the EXACT ZONE designated for testing.

3—Then you test the productive possibilities of the zone *immediately after perforating*—before the formation can be contaminated by the drilling fluid.

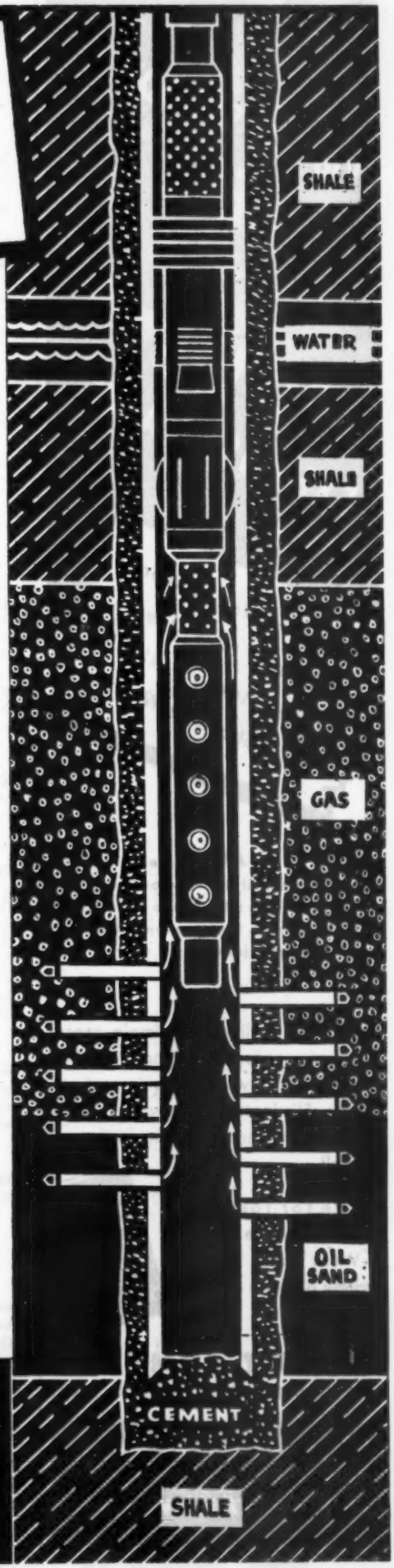
By enabling you to perforate and test on a single run, the McCullough Combination Gun Perforator and Tester also gives you maximum safety from blowouts. There is no time for the drilling fluid to become gas-cut, and, if necessary, heavy mud can be circulated into the well immediately after the test before the tester and tubing is removed.

To get three jobs done at once—with an important saving in costly rig time and scarce manpower, use the

Hard Shooting-exact SPACING

McCullough
Combination

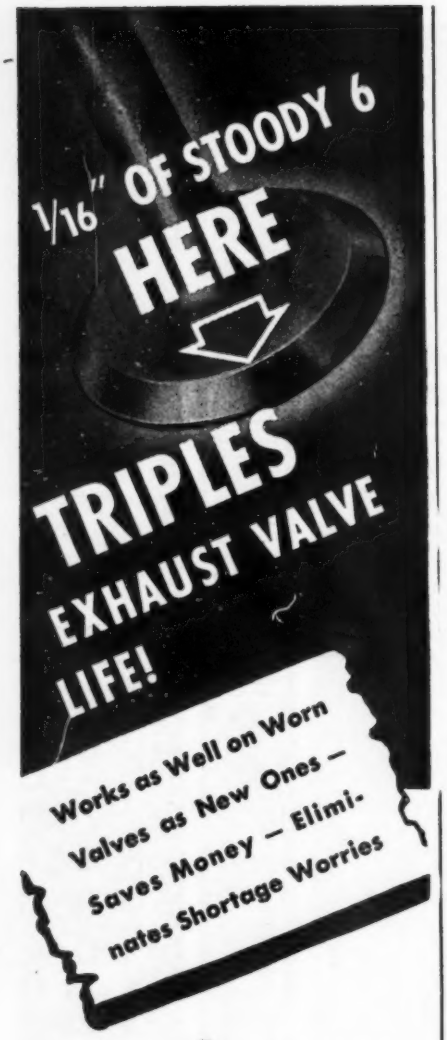
GUN PERFORATOR and TESTER



22 SERVICE LOCATIONS

McCULLOUGH TOOL COMPANY . . . 5820 South Alameda Street, Los Angeles 11, California
Export Office: 30 Rockefeller Plaza, New York 20, N.Y.

HOUSTON, TEXAS	TYLER, TEXAS	SHREVEPORT, LA.	CASPER, WYO.
WICHITA FALLS, TEXAS	McALLEN, TEXAS	HOUMA, LA.	LOS ANGELES, CALIF.
VICTORIA, TEXAS	ALICE, TEXAS	LAKE CHARLES, LA.	VENTURA, CALIF.
CORPUS CHRISTI, TEXAS	MAGNOLIA, ARK.	OKLA. CITY, OKLA.	BAKERSFIELD, CALIF.
GEO. WEST, TEXAS	NEW IBERIA, LA.	SEMINOLE, OKLA.	AVENAL, CALIF.
ODESSA, TEXAS			SACRAMENTO, CALIF.


1/16" OF STOODY 6
HERE
TRIPLES
EXHAUST VALVE
LIFE!
Works as Well on Worn Valves as New Ones — Saves Money — Eliminates Shortage Worries

AN ounce or two of **Stoody 6 welded to new or worn exhaust valve faces adds 300 to 400 percent to their normal life, prevents burning, saves overhaul jobs, costs only a few cents per valve.**

This folder outlines the simple procedure any garage or shop equipped with acetylene welding equipment can follow. Eliminates your worries about valve replacements and saves money as well.

Write for folder "Weld New Life Onto Worn Valves With Stoody 6" — no obligation.

STOODY COMPANY
1142 SLAUSON AVE., WHITTIER, CALIF.

STOODY 6-THE METAL THAT ADDS EXTRA MILES TO EXHAUST VALVE LIFE!

LAUGH WITH BARNEY

A man called on the news editor of a local paper and announced that his uncle had been taking the paper for 55 years.

"That's fine," said the new editor. "I hope he'll continue to do so."

"Oh, yes, he will. I want to tell you about him. He has always been a model of propriety. He has never touched liquor or tobacco. He has never been mixed up with women. He indulges in no vices and no excesses. And tomorrow he will celebrate his 80th birthday."

"How?" asked the news editor.

* * *

Howard: Me get married? No, sir, marriage makes me think of a cafeteria at noontime.

James: How so?

Howard: You just grab something that looks nice and pay for it later.

* * *

He: May I take you home?

She: Sure. Where do you live?

* * *

A WAC went for a walk in the woods. Coming to a beautiful lake, she decided to go swimming. She laid her clothes carefully on the ground and took a dip. As she emerged, she saw a lieutenant coming down the path. Not having time to dress, she hid behind a tree. The officer approached, stopped, and shouted, "Camouflage Company No. 1, forward march!" All the trees marched off.

* * *

And then there was the sweet young thing who thought smelling salts were sailors with B. O.

* * *

C. O.: Don't you know who I am?

Rookie: Nope, I'm a stranger here myself.

C. O.: I am the commanding officer of this post.

Rookie: That's a darn good job, bud, don't louse it up.

* * *

Blonde: Is it proper to hold a soldier's hand in the dark?

Brunette: Yes, and often necessary.

* * *

A pretty, young drill press operator in a defense plant expressed her relief after a visit to the doctor. "I have just found out," she said, "that those hard lumps in my arms are muscles!"

* * *

The September tax blanks remind us that income taxes are so high that people can make more money these days by being poor.

* * *

U. S. Slogan: "Back the Attack."
Jap Slogan: "Attack the Back."

* * *

Brought into court on a charge of violating price ceilings a St. Louis woman shopkeeper was asked whether she had not read the OPA rules. "Read them," she exclaimed, "why, I can't even lift them!"

* * *

Instruction to airplane spotter: If you see an airplane flying backwards, it's a German pursuit plane.

* * *

A sailor went to an auction. The auctioneer was offering a parrot. He bid $5.00. Someone said $10.00, the sailor bid $15.00. Again someone bid $25.00 and the sailor bid $40.00 and got the parrot. As he walked out he said to the auctioneer, "That's a big price to pay for a parrot, can he talk?" The auctioneer said: "You ought to know, he's the one that's been bidding against you."

* * *

Sign in a bar: "In case of a blackout do not leave bar. You may be lit and not know it."

* * *

Wife: I wonder if I'll live to be a hundred?

Hubby: Not if you pause much longer at 40, dear.

* * *

A lady overheard her colored maid make a rather short reply at the telephone and then hang up. She called to her:

"Mandy, who was that on the phone?"

"Tain't nobody, ma'am. Jes' a lady sayin' 'It's a long distance from New York,' and Ah says, 'Yas'm, it sure is'."

* * *

With a note of deep regret in his voice, the earnest social reformer was tackling the village reprobate.

"The last time I met you," he said, "you made me very happy because you were sober. Today I am unhappy because you are drunk."

"Yes," replied the bad lad cheerfully, "today's my turn to be happy."

* * *

"Oh, tell me," inquired a romantically inclined old maid of a young bride, "when did you first become acquainted with your husband?"

"The first time I asked him for money after we were married," was the instant reply.

* * *

"Last night, I questioned my husband for hours about where he'd been."

"What did you finally get out of him?"

"A fur coat."

* * *

It is possible to come out on top and still be a loser, as many a baldheaded man will testify.

* * *

Hubby: Darling, did you take a dollar bill out of my right-hand pants pocket last night?"

Wifey: Certainly not. Maybe you don't know it, but there's a hole in that pocket.

* * *

Visitor: Don't you cut yourself pretty often with this straight-edged razor?

Mountaineer: Nar, I been shaving nigh on to five years now and I ain't cut myself either time.

* * *

Clerk: Here's a pretty card with a lovely sentiment: "To the only girl I ever loved."

Sailor: That's fine. Give me a dozen.

* * *

Last night I held a lovely hand
A hand so wondrous sweet,
I thought my heart would burst with joy,
So wildly did it beat.
No other hand unto my heart
Could greater solace bring
Than that dear hand I held last night—
Four aces and a king.

* * *

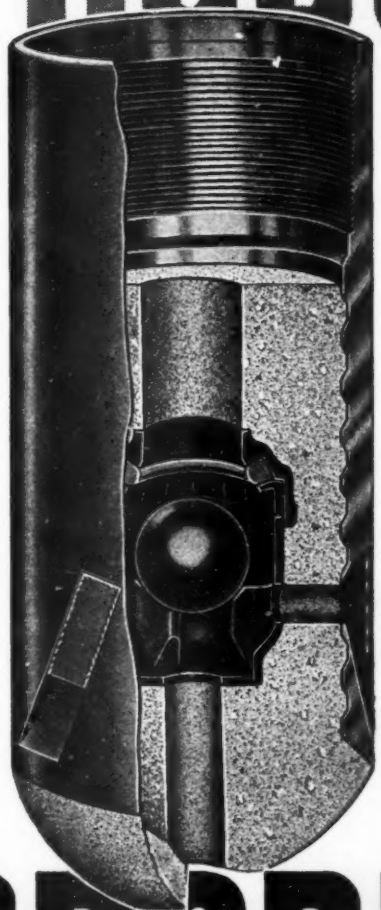
Two WACS accidentally went to sleep in the men's barracks. On discovering their mistake, one became frightened, screamed and ran.

The other remained cool and calm and collected.

PRODUCT "120"

provides that "whirling" action which minimizes danger of channeling, and places a uniform body of cement up above the shoe joint, with every assurance of "first-time" successful water shut-off. — That is the reason for its popularity, and why it is today more familiarly and widely known as Product "120" than by the name "BAKER CEMENT WASH-DOWN WHIRLER FLOAT SHOE."

PRODUCT "120"



also possesses the 3 vital features of Strength, Valve Efficiency and Drillability, pioneered and developed by Baker, plus that "whirler" action that "sends" the cement upward all around the casing after it is landed.

PRODUCT "120"

has additional important functions such as the washing action for removing bridges which may be encountered while running casing . . . and the washing, whirling action imparted to the fluid preceding the cement, which serves to produce the best possible conditions for a sound cement job.

Specify Product "120" for "first-time" cementing results.

BAKER OIL TOOLS, INC.

Houston—LOS ANGELES—New York

PRODUCT "120"

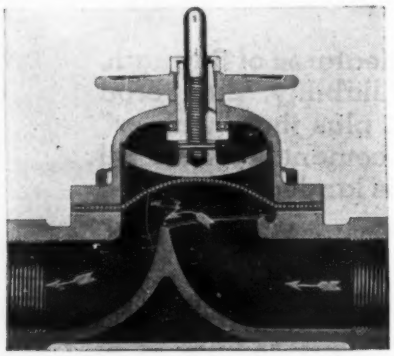
MACHINERY and EQUIPMENT

Diaphragm valve

McAlear Manufacturing Company, Chicago, Illinois, an affiliate of Hanlon-Waters Company, Tulsa, Oklahoma, has developed a new type diaphragm valve that has a broad application in the petroleum industry. Constructed of semi-steel and lined with rubber, glass or lead, this valve, designated as No. 1455, handles upward of 100 different kinds of acids, alkalies, abrasives, and suspended solids, the manufacturers state. The valve requires no repacking, no reseating, has no stuffingbox, and all moving parts are fully protected from the fluids handled, it is stated.

Special types may be operated from remote points by air or water pressure, by hand or automatic time clock or by a pilot valve.

No. 1455 diaphragm valve normally has a semi-steel body and bonnet with a stainless steel stem. It is available in 10 sizes from ½ in. to 6 in., screwed or flanged ends. The diaphragm is of molded synthetic composition selected for the particular service, and designed for maximum life under intended service operating conditions. No operating parts come in contact with the fluid carried.



The weir in the body is designed to give minimum resistance to flow. A continuous seat is provided around the inlet side of the weir giving positive, tight shut-off. The resilience of the diaphragm permits it to close tightly over and around any solid particles trapped on the seat.

The value is suitable for pressures up to 150 lb. and temperatures to 150°F.

This valve is available to the petroleum industry through Hanlon-Waters Company, 15 North Cincinnati Street, Tulsa, Oklahoma.

Fuel oil clarifier

Briggs Clarifier Company, Washington 7, D. C., announces an improved standard line of round tank fuel oil filters for diesel engines. New models have been added to broaden the application of Briggs Fuel Oil Clarifiers so that flow capacities range up to 500 gal. per hr.

Maximum working pressures and hydrostatic test pressures have been established to meet specific demands of the application. For small high speed diesel engines where pressures sometimes run well above 50 lb. per in., the clarifier is designed for a maximum working pressure of 100 lb. per sq. in., and is hydrostatically tested at 150 lb. per sq. in. For large, heavy duty diesels when pressure is usually between 15 and 25 lb., the clarifier is designed for a maximum working pressure of 40 lb. per sq. in. and hydrostatically tested at 60 lb. per sq. in. Pressure drop across the refills ranges from 0 to 50 lb. per sq. in.

Provision is made for registering pressure differential across the refill cartridges by installing one gauge in the upper compartment of the tank and another in the lower compartment. A glance tells the operator the exact pressure differential and when to change refills.

Improvements have been made in the refill holding assembly to assure a perfect seal of the refill cartridge.

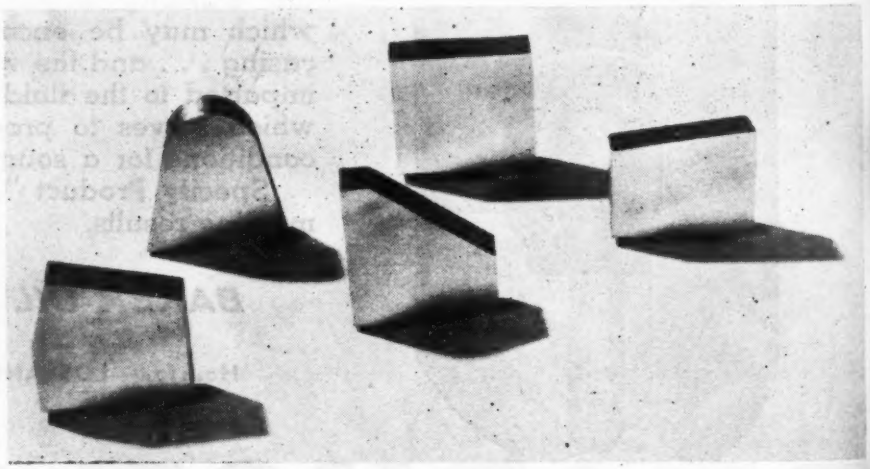
Fuel resistant stock

A new Buna N fuel resistant stock (233-5), which retains a tensile strength greater than 1000 lb. per sq. in. and elongation of more than 100 per cent after being subjected to aircraft engine oil at 300° F. for a period of 70 hr., has been developed by Los Angeles Standard Rubber, Inc., 1500 East Gage Avenue, Los Angeles.

This Buna N stock was designed for oil seals, oil rings, and other applications requiring resistance to aromatic fuels. It also remains flexible at 40° F. below zero and has a very low compression set.

Tool tips

Tool tips cast from Haynes Stellite cobalt-chromium-tungsten alloy are available for shops desiring to fabricate their own metal-cutting tools. They are made by Haynes Stellite Company, a unit of Union Carbide and Carbon Corporation, Kokomo, Indiana. Metal-cutting tools made by brazing these tips to steel shanks are recommended for jobs employing tools of large cross-sections or tools that are bent or offset, or in tool holders that make the use of solid tools impractical. Tipped tools also offer an additional advantage on operations that necessitate considerable overhang of the tool—the Haynes Stellite tool tip provides the redhard, abrasion-resistant cutting edge and the steel shank to which the tip is brazed provides the strength and toughness necessary to withstand the strain resulting from such operations.



Complete information on shapes, sizes, and prices of these tool tips is available from Haynes Stellite Company, Kokomo, Indiana.

Small size with BIG OUTPUT

THE NEW "Oilwell" No. 8-P Duplex Power Pump is designed for use where short over-all dimensions are desired. Its outstanding feature is large volume and high pressure output in relation to size and weight.

Two No. 8-P pumps can be mounted side by side on a truck body without exceeding 8-foot road clearance limits.

The No. 8-P is regularly equipped for slush pump service but suitable pistons and special valves can be furnished for pumping clear water, oil or other fluids.

FEATURES

1. One-piece rib-reinforced cast power frame designed for rigidity and accessibility.
2. Fully heat-treated single-helical gears.
3. Shim-adjusted tapered roller bearings.
4. Eccentric drive with full-floating bushings.
5. Combination oilbath and splash lubrication.
6. Flexible baffles on piston rods prevent mud or water from entering power end.
7. One-piece direct-flow fluid end assures efficiency at all operating speeds.
8. Removable liners.
9. Right or left-hand drive—pinion shaft can be reversed without disturbing main gear.

SPECIFICATIONS

Size, Bore x Stroke (Duplex)	inches	5 x 8
Liner Sizes	inches	3½, 4, 4½, 5
Rated Speed	r.p.m.	80
Recommended Brake Horsepower at Rated Speed		76
Theoretical Displacement (Piston Rods Deducted with Full-Size Liners at Rated Speed	g.p.m.	206
Maximum Working Pressure with Full-Size Liners	lbs. per sq. in.	540
Rated Fluid-Chamber Pressures: Suction	lbs. per sq. in.	900
Discharge	lbs. per sq. in.	1,800
Over-all Length (including Steel Skids)		8′ 10″
Over-all Length (less Skids)		8′ 0″
Over-all Width (including Pinion Shaft Extension)		3′ 2″
Over-all Height (including Steel Skids)		3′ 2½″
Weight Mounted on Wood Skids: Domestic	pounds	5,050
Export	pounds	5,425

Send for additional information

OIL WELL SUPPLY COMPANY

Executive Office — Dallas, Texas
Division Offices—Columbus, Ohio
Dallas, Texas Los Angeles, Calif.
Export Division Office—
30 Rockefeller Plaza
New York City

Branches Serving All Oil Fields

UNITED STATES STEEL

"Oilwell" No. 8-P (5" x 8") Duplex Power Pump for Slush Pump and General Service.

"OILWELL"

Air circuit breaker

In keeping with the trend toward oil elimination in indoor switchgear equipment, a new Ruptair magnetic type air circuit breaker has been developed by Allis-Chalmers, Milwaukee, Wisconsin, and is now available in high voltage, oilless switchgear rated 5000 volts and below and 150,000 kva. interrupting capacity and below. The Ruptair breaker has overall dimensions as compact as standard oil breaker switchgear, with all parts readily accessible.

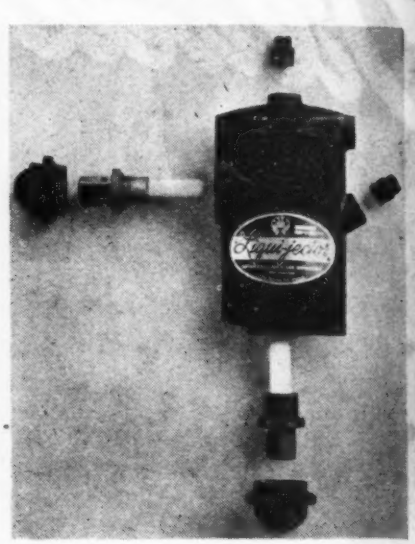
In the new air breaker the arc chute has been fully coordinated with the contact and arc runner design to give consistent and reliable interruption through the entire range of current to be interrupted. The magnetic circuit, consisting of one husky blowout coil and two laminated iron pole pieces per phase, is arranged to force the arc up into the arc chute immediately upon separation of the arcing contacts.

Complete inspection and maintenance of the self-contained contact assembly can be accomplished without disturbing the arc chute or magnetic circuit.

Liqui-jector

A new principle for automatically and continuously removing condensate (droplets, slugs, or mist) from compressed air and gas lines in the oil and gas industries is announced by Selas Corporation of America, Philadelphia, and is embodied in a new family of "Liqui-jectors," adaptable to air and gas lines up to 1¼-in. pipe size and normal line pressures. No moving parts are involved, and no cocks, traps or shutoffs are required in the drain line, which is open to the atmosphere. Action is entirely automatic and continuous through two porous ceramic tubes, one inherently water-repellent, the other water-permeable but air-impervious.

Basis of the product is a recently discovered method for automatically separating liquid and gas phases by virtue of the surface tension of the liquid. Compressed air entering the Liqui-jector passes through the first (and water-repellent) tube where it is stripped of moisture. The action is by coalescence of droplets on the surface of this tube—



a coarse ceramic material with an average of 50,000 pore openings per square inch, each so small that the pressure drop across the tube is insufficient to permit water passage against the resisting diaphragm-action of its surface tension. The coalesced moisture drops to the bottom of the unit where it passes through the second tube, without loss of air, to outside atmosphere. This second tube is constructed of micro-porous porcelain, with an average of 720 million pore openings per square inch, and being constantly wet by its wick action, constitutes a perfect air seal up to the rated limit working pressure of the unit.

The first perfected and smallest unit, Model A-150-1, shown in the accompanying illustration, accommodates lines up to ⅜-in. pipe size with line pressures up to 100 lb. per sq. in. Other units are now being perfected to handle the greater demands of the larger lines.

The physical design, as well as the versatility, of this unit is an important feature, for its oval shape permits flush-against-the-wall installation—directly in the line—without the addition of elbows or other fixtures.

A unique inflection of this separation principle has resulted in the development of larger units, now in pilot plant operation, for production line liquid-liquid and liquid-gas separations.

THIS RELEASING AND CIRCULATING
SPEAR
has a QUICK POSITIVE RELEASE
Adaptable to drill pipe, tubing and casing jobs, this American Iron & Machine Works Co. releasing and circulating spear can also be effectively used in setting liners, screens and similar production jobs. Each spear can be equipped with special slips which makes it very flexible in catching many varied sizes!
A AMERICAN
IRON AND MACHINE WORKS CO.
OKLAHOMA CITY, OKLAHOMA
Houston and Monahans, Tex.; Harvey and New Iberia, Louisiana; Great Bend, Kansas. Export office: 420 Lexington Ave., New York City
California Representative:
Hopper Mch. Wks., Inc., Bakersfield, Cal.
WE'RE SERVING
UNCLE SAM, TOO
Not only has the American Iron & Machine Works Co. been doing its best to meet the needs of the oil industry, but we've also been up to our ears in war work.

Old 376...USED WHERE OTHER TRUCKS STALL IN WEST TEXAS SAND

Down in the West Texas oil country, where shifting sand hills stretch interminably in all directions, Old Faithful No. 376—a Marmon-Herrington *All-Wheel-Drive* converted Ford—has metered more than 30,000 miles of tough going, as an instrument truck for the Gulf Research & Development Company.

Still going strong, though in constant service since 1937, No. 376 carries Gulf seismograph crews into country impossible to penetrate with conventional type trucks. A new fleet of Marmon-Herrington *All-Wheel-Drives*, recently placed in service, will extend this company's search for oil through the worst the sand hills have to offer.

Essentially, Marmon-Herrington vehicles are, and always have been, trail blazers—designed and constructed to speed man's conquest of nature's most impregnable strongholds. Now in the vanguard of United Nations' forces, helping to forge a band of steel around civilization's enemies, they will be back again after the war to contribute importantly to the development of the world's natural resources.

★ BUY MORE IN '44 . . . 5TH WAR LOAN BONDS ★

MARMON-HERRINGTON *All-Wheel-Drive* TRUCKS

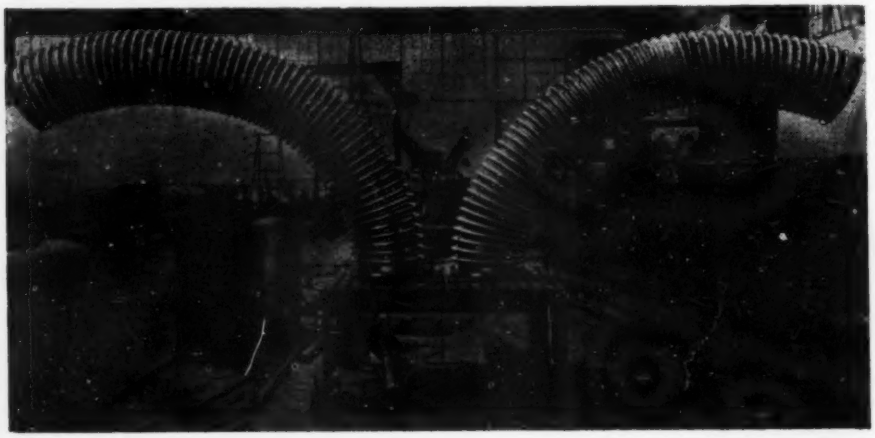
MARMON-HERRINGTON CO., Inc., INDIANAPOLIS 7, INDIANA

Cable Address: MARTON

Corrugated flexible connectors

Large diameter flexible corrugated stainless steel tubing is being manufactured, for the first time, in long bent lengths. Pictured are two 16 in. diam. by 9 ft. diesel exhaust connectors bent to 110° for an important war use.

Extensively used on diesel engine exhaust and high temperature vapor lines, these connectors have inherent advantages of value to the chemical, power, and petroleum industries. It remains only to apply this development to existing problems in these fields, according to the manufacturer.



The connectors absorb expansion, contraction, and extreme deflection in all planes. Supplied in sizes 6 in. diam. and larger in carbon steel, any type of stainless steel and other corrosive-resistant alloys, they require no packing and, having no seams, are permanently gas-tight. The connectors handle corrosive liquids and gases under pressures up to 30 lb. per sq. in. and at temperatures from subzero to 1800°F. Connectors for absorbing linear expansion only can be supplied for pressures up to 300 lb. per sq. in.

For further information write to Zallea Brothers and Johnson, Wilmington 99, Delaware.

Nubun

Nubun, a new synthetic rubber latex insulation for power, lighting, and communication cable has been developed by United States Rubber Company, it is announced by C. W. Higbee, manager of the wire and cable department.

The new insulation is a result of war time developments in rubber technology and will permit the design of new types of wire and cable with improved electrical and physical characteristics.

Made by the now famous latex continuous dip method, Nubun will have great advantages over ordinary wire where replacement and space are important factors, Higbee says.

Qualities of Nubun insulation cited by Higbee include flexibility, impermeability to water, laminated construction, and perfect centering of the conductor to produce an insulated wire of maximum conductivity and minimum diameter. The synthetic insulation is said to be exceptionally homogeneous following vulcanization and has high electrical characteristics such as dielectric strength and insulation resistance. The special synthetic rubber compound is low in specific conductive capacity, has good aging qualities because of the presence of special antioxidants, and will resist severe wear because by the nature of the latex process, the rubber particles are not distorted or broken by milling.

Nubun insulation is made from a special modification of buna S rubber.

Justrite Safety Lantern

Thousands in the petroleum industry today are making good use of the Justrite Safety Lantern for safer "midnight patrols."

And, the Justrite Twin-Bulb Safety Lantern is safe . . . approval by Underwriters' Laboratories, Inc. attests to this.

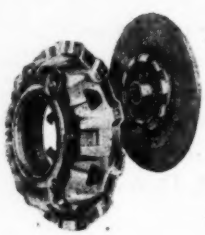
So, wherever you need safe light . . . around wells, rigs or pipelines . . . use the safe light . . . Justrite.

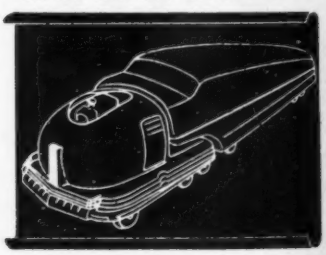
JUSTRITE MANUFACTURING COMPANY
2063 N. Southport Ave., Dept. G-2, Chicago 14, Ill.

HOW "HALF-TRACK" Clutch-Control WILL HELP IMPROVE the Mobility of TANK TYPE TRUCKS

—and develope streamlined designs having compact, economical operation features.

ROCKFORD
Spring Loaded
CLUTCHES





provide convenient control and smooth gear changes—maintaining disengagement by light foot-pedal pressure. Consult our engineers freely concerning advantageous use of ROCKFORD Spring Loaded CLUTCH features in your new and improved models.

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSION CONTROL

It tells and shows how ROCKFORD CLUTCH and POWER TAKE-OFF application are saving time, power and money in oil field equipment and a wide variety of industries. Gives capacities, dimensions and specifications.

Rockford Drilling Machine Division Borg-Warner Corporation
1303 Eighteenth Ave., Rockford, Illinois, U.S.A.

100,000 TONS OF STEEL

Pave Airways to Tokyo and Berlin

The world's finest air force flying the world's finest warplanes was not enough.

To translate air force into air power called for highly mobile air bases around the globe.

Since shortly after Pearl Harbor Butler factories have fabricated a hundred thousand tons of steel into pierced steel landing mat which sailors and soldiers speedily lay into landing strips.

For these air bases also, Butler plants have fabricated other thousands of tons of steel into steel hangars, machine shops, warehouses, truck and trailer tank refueling units, and bolted steel tanks for aviation gasoline.

To the limit permitted under such war conditions, the field service organizations listed below are working to provide the most dependable field tank service to be found anywhere.

BUTLER MANUFACTURING COMPANY
Galesburg, Ill. Kansas City 3, Mo. Minneapolis 14, Minn.

BUTLER BUILT
BOLTED STEEL TANKS
Walkways and Stairways

Field Service Organizations

AMERICAN PIPE AND SUPPLY COMPANY
Denver, Colo. Casper, Wyo. Cut Bank, Mont.

HARRY G. MILLER
El Dorado, Arkansas

WRAY G. RICHARDS
Alice, Longview and Luling, Texas

CRAWFORD TANK AND SUPPLY COMPANY
Dallas, Houston, Odessa, Corpus Christi, Texas
Lake Charles, Houma, Shreveport, La.
Great Bend, Kans.; Tulsa, Okla.

Insulating materials

The insulation division of the Eagle-Picher Sales Company announced through T. C. Carter, vice president and general manager, the addition of four new products to its comprehensive line of insulating materials.

Eagle-Picher has named the new products, "Eagle Swetchek," "Eagle Drycote," "Eagle Hadesite," and "Eagle '43' Finishing Cement."

Eagle Swetchek, an insulation for minimizing condensation, for use on cold water lines, water coolers and softeners, storage tanks, filters and condensers, was described as a prepared plastic coating exceptionally resistant to abrasion, and black in color.

Eagle Drycote, companion product to Eagle Swetchek in effectively combating condensation, is a plastic coating, white in color, and packaged in dry form. When mixed with water and applied by trowel or hand application to any clean dry surface, Eagle Drycote becomes smooth and glossy white in color and sets into an extremely hard surface. It is highly fireproof.

Eagle Hadesite is a fireproofing insulating cement for high temperature work. Mixed with water Hadesite is trowled to a smooth hard finish of salmon color and is used primarily for fireproofing structural steel, lining high temperature ducts, firedoors, etc. Hadesite is used to temperatures to 1900°F.

Eagle "43' Finishing Cement is used for finishing interior insulation work where an extremely hard, smooth surface is desired. It can also be painted and withstands temperatures to 800°F.

High frequenecy generators

For both induction and dielectric heating loads, a complete line of high frequency generators with ratings of 1, 2, 5, 10 and 20 kw. in line with NEMA standards is announced by Westinghouse Electric and Manufacturing Company.

Completely self-contained, the units require only electrical connection to a 60-cycle power supply and have no external cooling or other auxiliaries. Units of 50 to 200-kw. capacity can be supplied in addition to standard one to 20-kw. ratings. The primary voltage is 220 or 440 volts, single phase for ratings of 5 kw. or lower and 3 phase for 10 kw. and higher. Housed in the single cabinet are the oscillator, power supply, blower, and necessary switchgear. The high frequency section is completely shielded to minimize the possibility of interference with nearby communication circuits.

Air-cooled tubes are used in the standardized generators. Their use eliminates bulky water cooling equipment and allows complete portability of the 2, 5, and 10-kw units and increased portability of the 20-kw unit. The air blower for cooling the tubes provides a circulation of air throughout the entire equipment, insuring a greater factor of safety and permitting a reduction in size.

The high-frequency oscillating circuit varies with the kilowatt rating and frequency needed. The circuits selected entail the least number of controls, are simple to adjust and operate and have the greatest overall efficiency. For capacities through 10 kw the type of circuit permits frequency shift as the characteristics of the load change during the heating cycle in such a manner that the load on the tube anode tends to approach unity power factor. In the 2, 5, and 10-kw. generators, the load can be coupled to the work without the use of an external impedence-matching network when the work and generator are close together. A separate network is available for greater distances to the work and for use with the 20-kw unit.

Generators are available for frequencies of 450 kc, 5, 15 and 30 mc. for ratings through 10 kw. and 450 kc., 2 and 10 mc. for 20 kw. and higher. This range of frequencies provides for adequate handling of all types of induction and dielectric problems.

Single-phase, full-wave mercury-vapor rectifiers provide the anode current for generators under 10 kw. For capacities of 10 kw. and larger, a three-phase, full-wave rectifier, utilizing 6 mercury-vapor tubes is used.

2 Responsible Engineering Positions Immediately Available

Mechanical Design Engineer with hydraulic and electrical experience, preferably but not necessarily with oil tool industry background, to fill a highly responsible and permanent position reporting directly to the Chief Engineer. Must know strength of materials, higher mathematics and dynamics of moving members. Please outline educational and practical background completely and indicate present salary requirements. Enclose recent photo. See address below.

✶

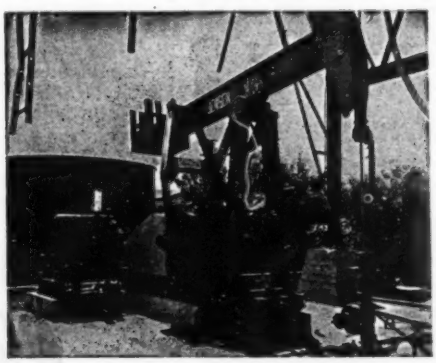
Production Designer and Engineer with proven ability to analyze and adopt existing products for other industrial applications. Must be able to efficiently coordinate tooling, materials, processes and manpower now being used for manufacture to meet other industrial demands. Experience in hydraulics desirable but not required. This position reports directly to the Chief Engineer. Please outline educational and practical background completely and indicate present salary requirements. Enclose recent photo.

✶

These positions are to be filled by our client, the West Coast Division of a leading national manufacturer. Your response will be held in strict confidence. Please address:

THE SHAW RESEARCH BUREAU
816 West Fifth Street, Los Angeles 13, California

To Improve any Well



JENSEN Pumping Units are intended to make wells more profitable and satisfactory . . . They generally do.

Have you noticed that you seldom see a JENSEN Unit by itself? When you see one, you see many.

To improve any well, try a JENSEN. Many of our best customers got started that way.

Talk with your JENSEN dealer and with JENSEN owners. See the Composite Catalog and write us for Bulletin No. 27.

JENSEN
BROTHERS MFG. CO.
Coffeyville, Kansas, U. S. A.
Export Office: 50 CHURCH STREET, NEW YORK CITY

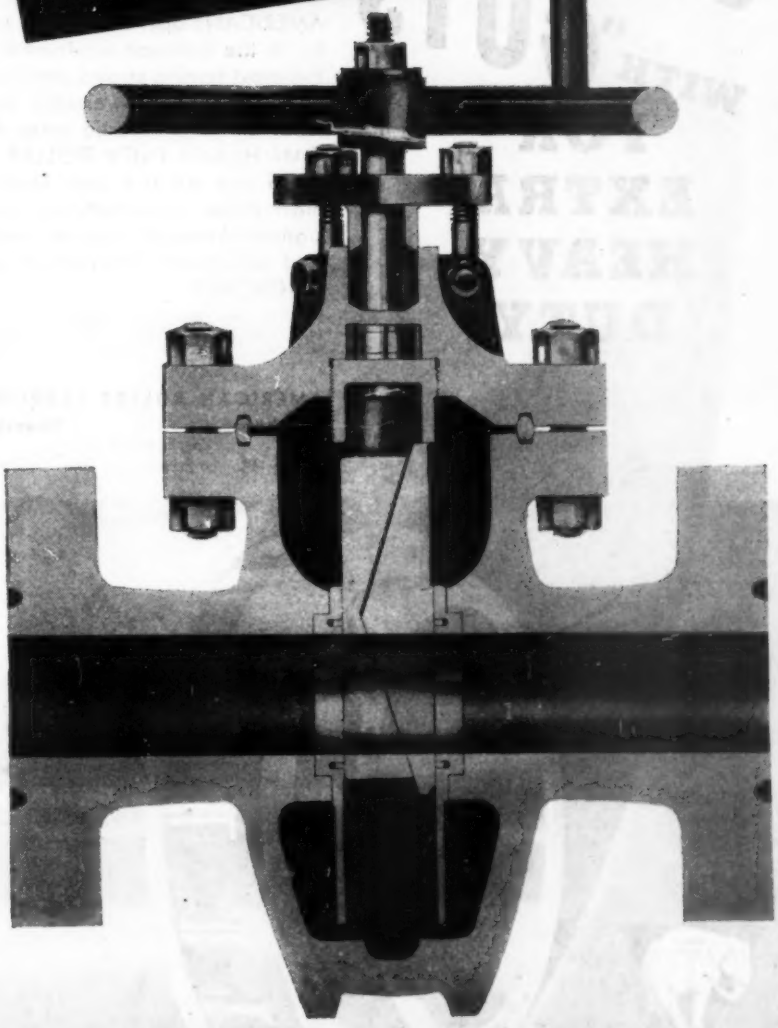
Only IN W-K-M VALVES

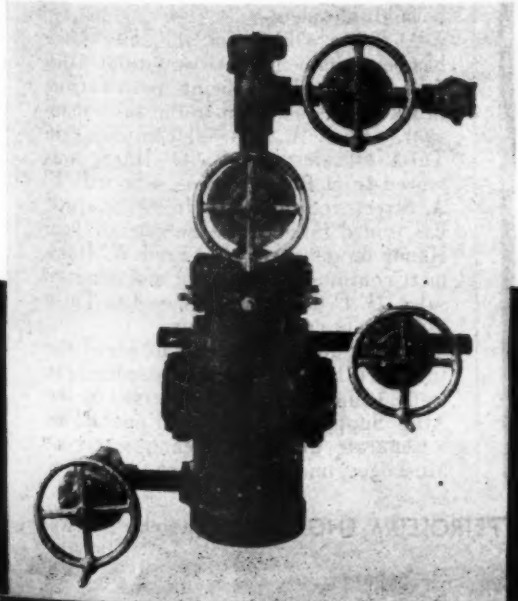
This LUBRICATION *Feature*

The design of the W-K-M Valve permits a method of lubrication not possible in any other valve. Both the body and bonnet serve as a grease reservoir, containing a surprisingly large amount of grease. The 3" Valve, for example, holds about 6 pounds, enough to last indefinitely.

Every moving part of the valve is constantly in a bath of lubricant. The gate is submerged in grease at each operation, which contributes to the remarkable ease of opening or closing, however, the W-K-M Valve does not depend on grease to make a perfect seal. Such complete lubrication absolutely prevents internal corrosion and reduces friction to a minimum, both of which so often cause valves to leak.

This is another of the several reasons why you may be sure that a W-K-M Valve will always effect a complete shut-off and will always open or close under full rated pressure.





The Valves Make The Tree

J. & L. personnel changes

With the recent acquisition of all stores and inventory of the Atlas Supply Company, which was maintaining a number of stores and offices in the same cities where Jones and Laughlin Supply stores or offices were also situated, a consolidation of stocks and personnel was necessary. These changes have resulted in a re-grouping of some districts.

Northern Oklahoma district now includes the Cushing store with H. L. Ottinger, store manager. A. A. Hopper, district sales manager continues in charge with headquarters at Bartlesville.

Central and southern Oklahoma district, under district sales manager, L. R. Roberts, will include the Duncan and Healdton stores, B. R. Bourland and R. C. Trewhitt being respective store managers. The Oklahoma City store, now housed in former Atlas Building, is under store manager Wm. H. Whatley, with R. M. Estes, formerly of Atlas, as assistant store manager. H. D. Strong and R. C. Shaw are salesmen.

The Kansas district will have headquarters in Union National Bank Building, Wichita, under C. E. Robertson, district sales manager, with R. B. Yanaway as assistant district sales manager, both men being formerly with Atlas. At Russell, Kansas, the store is now in the former Atlas Building under R. P. Watson as manager and R. D. Goodnight, salesman. Watson being a former Atlas man. Former Atlas stores at Bushton and McPherson, Kansas, are under the same store managers, W. P. Knowles and DeLoss Parr, respectively.

The Rocky Mountain district, under M. A. Park, district sales manager, is a newly created district with offices at Cody and Casper, Wyoming. The Powell, Wyoming, store is under Paul Stunkard, store manager, with W. H. Sidell as salesman.

The West Texas district, under C. W. Moore, district sales manager, has been enlarged to include the former Atlas store at Artesia, New Mexico, under former store manager A. B. Sloan with T. Shirley Hager continuing as salesman. The store at Kermit, Texas, has been consolidated in the Jones and Laughlin supply store, under store manager R. L. Daniels with H. H. Ray as salesman. Assisting Moore will be G. E. Mershon as assistant district sales manager, located at Midland, Texas.

The Louisiana-Arkansas-East Texas district, has been enlarged. A. G. Bastian continues as district sales manager with J. A. Evans, Jr., who returns after a 2 year assignment with the engineering and construction division, as assistant district sales manager. Former Atlas stores at Gladewater and Overton, Texas, are continued under store managers R. D. Dickinson and J. K. Weller, respectively. E. C. Bynum continues as salesman at Overton.

The Illinois-Kentucky district, under U. G. White, Jr., district sales manager, now includes the former Atlas store at Grayville, where R. L. Gibbons continues as store manager. The new store at Henderson, Kentucky, is under R. G. Wallace as store manager. At Salem former Atlas stocks have been consolidated in the Jones and Laughlin supply store under store manager A. H. Crenshaw.

The Pennsylvania-Ohio-West Virginia-southern New York district will include the recently opened store at Canton, Ohio, with Forrest McAdams as store manager, and H. C. Goodwin as salesman. To this district under district sales manager, H. E. Wagner, Pittsburgh, Pennsylvania, has been added A. M. Schillinger, formerly with PAW District 1, New York area, and William Ferguson, previously with Jones and Laughlin, as field salesmen.

At Tulsa, Oklahoma, the sales force has been augmented by two former Atlas men, R. E. Howe, being moved from Muskogee as assistant to the sales manager, and J. A. Fretwell continuing in Tulsa as salesman. W. O. Hardy was moved from Pratt, Kansas, who with F. A. Street, recently back from the army, has joined forces with the veteran Tom Haney on general sales. Fred W. Hammett continues on refinery maintenance sales. H. U. Everett has moved to Tulsa as assistant credit manager.

Atlas Supply Division, to serve the industrial, irrigation, and plumbing trade, which had long been served by the Atlas Supply Company, will operate as a separate unit with headquarters at Muskogee, under J. R. Brooks.

BUILT WITH "GUTS" FOR EXTRA HEAVY DUTY
AMERICAN HEAVY DUTY ROLLER BEARINGS have built into them the vital extra capacity for continuous 24-hour-a-day performance under the most gruelling service conditions possible. Brutally strong . . . simply constructed . . . precise . . . AMERICANS operate quietly, smoothly, in the heaviest equipment under the most terrific strains and impacts. Longer, safer, lower-cost, trouble-free service is assured when AMERICAN HEAVY DUTY ROLLER BEARINGS are on the job. That's why most major manufacturers and designers of heavy industrial machinery and oil country equipment specify AMERICANS.
In your next heavy-duty installation, ride the load on AMERICANS. Our engineers will welcome your roller bearing problems. Write today.
AMERICAN ROLLER BEARING CO.
Pittsburgh Pennsylvania
Pacific Coast Office:
1718 S. Flower Street Los Angeles, Calif.
HEAVY DUTY
AMERICAN
HEAVY-DUTY
ROLLER BEARINGS

A WORLD'S RECORD
For Continuous Performance

SHUT-DOWN TIME 1/10TH OF 1%

"Good Old Number 1", shown at left, has been the prize performer in this battery of CLARK "Angles" at the La Gloria Corporation recycling plant, Falfurrias, Texas. It is undoubtedly the world's champion compressor unit for continuous operation. Number 1 was shut down, in the year 1942, due to engine fault or repairs, exactly 70 minutes . . . has shown comparable performance throughout the two and a half years it has now been in operation. A year contains 525,600 minutes. 70 minutes is less than 1/100th of 1% of the total.

But this entire battery of 11 8-cylinder, 800 horsepower "Angles" were only shut down an average of 8 hours each, during 1942, due to engine fault or repairs. That was only 1/10th of 1% of the total time and is undoubtedly another world's record.

CLARK perfected 2-cycle design explains the amazing record of these engines.

Economy of lubricating oil consumption has been equally amazing. This battery started operation May, 1941. In two and one-half years, oil has been changed in only one engine. The cause was a bad piston. There was no sign of sludge in the oil, and crankcase walls were clean.

Call on CLARK engineers for the whole story of CLARK "Angle" performance.

CLARK BROS. CO., INC., OLEAN, NEW YORK, U. S. A.

CLARK

One of the D

Sketch showing details of Diamond Drive on Clark 8 cylinder 800 H. P. engine illustrated above

And the Timing Drives are Diamond

CONTINUOUS performance records demonstrate good engine design, excellent construction,—*and* proper selection of all parts and accessories . . . Vitally important in engine performance are the timing drives—for these too must match engine design and construction—must meet engine designers' needs exactly.

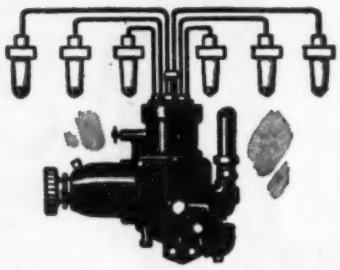
Clark, among the leading gas and diesel engine builders, chooses Diamond Roller Chain Timing Drives for their uniform accuracy, precision, endurance,—quietness and smoothness. Such drives require least attention, operate unfailingly for long periods,—help make possible continuous performance records.

Whenever great advances are made in machinery and equipment, you will find Diamond Roller Chains contributing in some essential capacity—a fact proven again during the past 15 years of rapid development of diesel and gas engines. Chances are that your present machinery or projected models can be improved through use of Diamond Drives,—drives for very high speeds of great precision,—drives for large and small machinery, electric motor and engine drives of all capacities up to 2000 H. P.

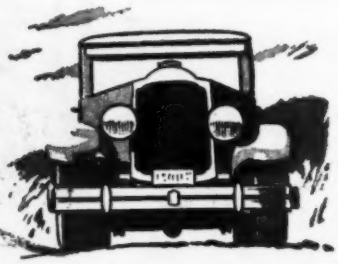
Recommendations based on over a half century of cooperation with machinery builders and industry, can help save your time. Let us have your data. DIAMOND CHAIN & MFG. CO., 441 Kentucky Avenue, Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities.

DIAMOND **ROLLER CHAINS**



Dependable diesels are not built in a day. For instance, in perfecting the *exclusive* Cummins Fuel System, now an accepted model of simplicity and efficiency, 3,000 different injection mechanisms were developed and tested between 1923 and 1927 before Cummins engineers were satisfied. Insistence on "making it right," regardless of cost, explains why Cummins Diesels are known everywhere as *the dependable diesel.*



A Cummins-powered Packard sedan was the world's first diesel-propelled automotive vehicle. Driven in 1930 from Columbus, Ind., to New York City by designer-president C. L. Cummins at a fuel cost of only $1.38, the car was barred from the New York Auto Show and, later, the Atlantic City Road Show. Today, Cummins Diesels are found in practically all leading makes of heavy-duty trucks and construction equipment.

In 1930, under AAA sanction, the world's first official record for diesel-powered vehicles was established at Daytona Beach, Florida, by a Cummins Diesel installed in a Packard roadster—83 mph. The engine was a "dolled up" Model U designed for marine service. Although built to operate at 800 rpm., it was revved up as high as 1900 rpm. during the run, without any difficulties developing.

CUMMINS DEPENDABLE DIESELS

Automotive Models: Designed for all types of heavy-duty trucks in either highway or off-the-highway service.

★ ★ ★

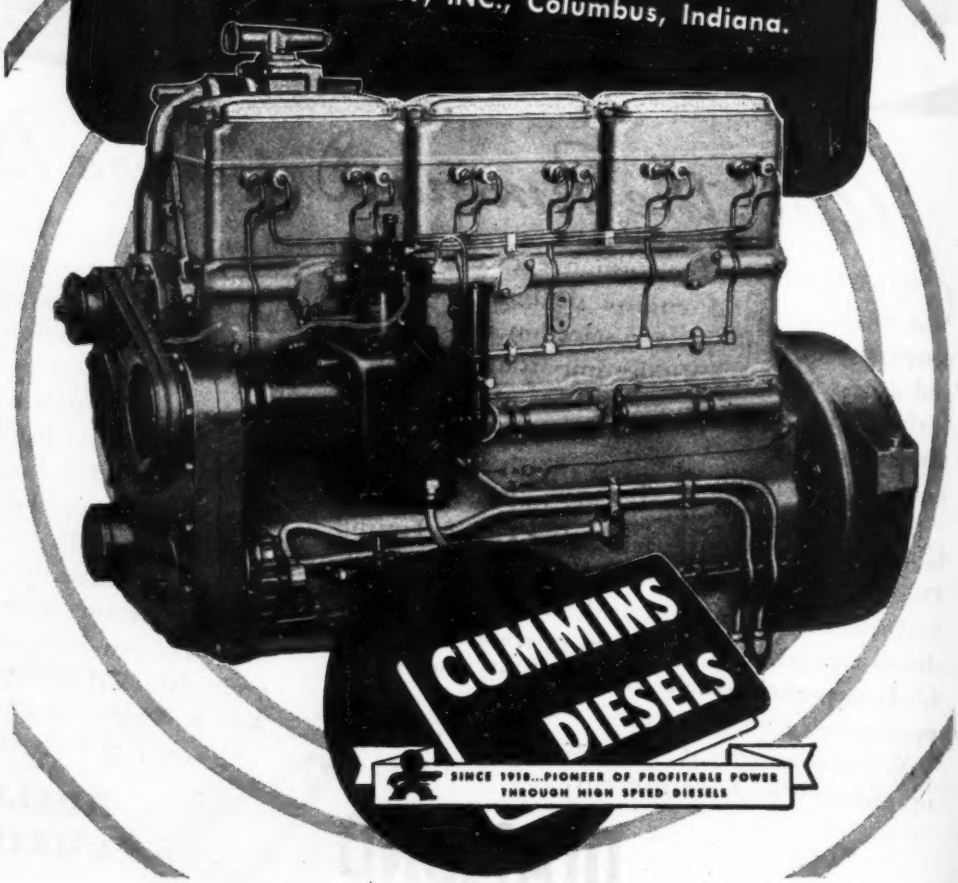
Industrial Models: Portable and stationary engines, power units, and generating sets for service in any industry requiring heavy-duty power.

★ ★ ★

Marine Models: Propulsion engines and marine type generating sets designed for all types of fishing boats, work boats, and pleasure craft.

Makers and Breakers of Precedents in Power

In the early 20's, most authorities conceded 600 rpm. to be "tops" for a diesel. Cummins conceded nothing—bumped the Cummins Diesel of that early day up to 900 rpm. and kept right on bumping. That's how the modern, high speed diesel was created . . . by making *and breaking* one precedent after another . . . by doing things in design, construction and metallurgy "that couldn't be done." As a result, today's high speed Cummins Dependable Diesels are doing tough, heavy-duty jobs scarcely dreamed of twenty, or even ten, years ago. Not only doing them, but doing them cheaper, better and faster than they were ever done before. CUMMINS ENGINE COMPANY, INC., Columbus, Indiana.



Marsh elevated

The board of directors of The Kennedy Valve Manufacturing Company, Elmira, New York, announces the election of Leon H. Marsh as vice president and sales manager.

Marsh has been associated with the company for more than 25 years. After having been assistant sales manager for many years, he was made acting sales manager in 1941, upon the death of Clarence H. Kennedy, who had been the company's vice president and sales manager; and was promoted to the position of sales manager in 1942.

Expands service

The electrode service engineering department of National Carbon Company, Inc., has been reorganized and enlarged, according to a company announcement. An increased number of technical advisers have been assigned to act as field consultants on the proper application techniques, the efficient use, and the development and improvement of carbon and graphite electrodes in electrometallurgical and electrochemical applications.

The company announcement stated that T. L. Nelson is in charge of the enlarged department, which will consist of two divisions. Dr. Neal J. Johnson has been named to head the department's electrolytic service division, and Dr. Charles H. Chappell is in charge of the electrothermic service division.

Nelson has been with National Carbon Company since 1919. A graduate of Cornell University, where he held an assistantship in analytical chemistry, he became chief of the company's works control and process engineering laboratories at Niagara Falls, New York. Transferred to Cleveland in 1929 and placed in charge of the quality division of the carbon division, he has concentrated on the problems of quality control in the company's list of carbon products. Reorganization of the electrode service engineering division will permit him to devote his full time to electrode application problems in the electrometallurgical and electrochemical industries.

Johnson has made outstanding contributions in the electrolytic field through his work with graphite anodes. His achievements in developing National Carbon Company's high-quality, oil-treated anode was particularly valuable to electrolytic processes. He joined National Carbon Company immediately after receiving his doctorate from the University of Wisconsin in 1934. He has successively been in charge of the electrolytic division of the process engineering laboratory at Niagara Falls, and then head of the Niagara works laboratories.

Chappell is responsible for many of the improvements in electrode quality that have been developed in the last 5 years. He obtained his doctorate at Iowa State College in 1935, and entered the National Carbon Company research laboratories in 1936. Since 1939 he has been in charge of the electrothermic division of the Niagara Falls laboratories.

Named to new office

Ralph B. Lloyd, president of the California Oil and Gas Association, announced the appointment of Don E. Gilman to the newly created office of executive vice president. The appointment follows recent consideration by the board of directors of enlarging the scope and functions of the association. Gilman assumed his new duties September 1.

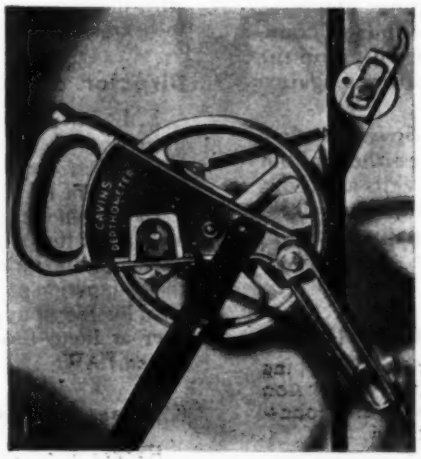
At the same time, Lloyd announced the promotion of D. S. Kilgour from the position of assistant secretary, which he has held for a number of years, to the office of secretary of the association.

Speaking of Gilman's appointment, Lloyd said, "Don Gilman is eminently qualified, for although he has not been identified with any of the oil or associated companies, he has long been familiar with the problems of the oil industry. His wide acquaintance with petroleum people, as well as in Pacific Coast advertising, newspaper, radio, and business circles, adapts him particularly to the extension work the association expects to do."

To accept the position of executive vice president of the California Oil and Gas Association, Gilman has resigned as vice president and western executive of the Blue Network Company. Prior to that, he was vice president of the National Broadcasting Company. He has been associated with advertising, public relations, and executive administration all his business life. He was formerly president of the Pacific Advertising Association and vice president of the American Federation of Advertising.

Depthometer

The Cavins Company, 2853 Cherry Avenue, Long Beach, California, has developed a Depthometer designed to measure well depths during bailing, swabbing, and similar operations, when tools are being run on sand lines. The



device is highly portable (24-lb. shipping weight including carrying case) and can be attached to the line in a few seconds' time. The Depthometer does away with "stringing-in" to determine depths, the manufacturer states. It is recommended by the makers as standard equipment for well pulling crews.

Successful

DUAL COMPLETION

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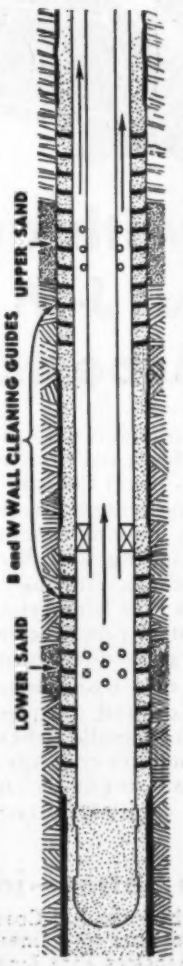
Wall Cleaning Guides



The advantages of dual completions, including the large savings of steel, increased production, etc., indicate an increase in this type of completion during the present emergency.

The first requirement in a successful dual completion is a good cement job. A good cement job is one where the set cement entirely fills the annulus and is in bond with the formation to maintain oil, gas and water in their original position and to prevent the migration of any fluid behind the casing.

B and W Wall Cleaning Guides, placed as shown in the diagram throughout the sections to be produced, scratch off the mud cake, center the casing, and insure the proper placement of the cement slurry in bond with the formation.

BRUCE BARKIS — **B and W, Inc.** — KENNETH WRIGHT

Well Completion Specialists

WEST COAST: 3545 Cedar Avenue
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Underscoring this achievement—on more than 50,000 miles of oil and gas pipe line throughout the world—Johns-Manville Asbestos Felts are today safeguarding protective coatings against soil stress and distortion. Asbestos fibers—inorganic and non-tubular—prevent capillary attraction. They *cannot* rot or decay!

Do the job better—in less time!

For full details on how the J-M Coating and Wrapping Machine can guard your own lines against corrosion with lasting J-M Asbestos Pipe Line Felt, write Johns-Manville, 22 East 40th Street, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville *Asbestos* **PIPE LINE FELTS**

Campbell to new post

W. T. Crowe, general manager, Detroit Diesel Engine Division, announces the opening in Tulsa, Oklahoma, of a branch office from which will be handled the distribution of General Motors diesel engines in the petroleum industry.

Arch Campbell

Arch F. Campbell of Tulsa will manage the sale of the products of Detroit Diesel Engine Division in this field. Campbell is well known throughout the petroleum equipment field. After his graduation from the University of Michigan and his experience as a flying officer in World War I, he has served as branch manager of the Waukesha Motor Company, sales manager of the Superior Engine Division of National Supply Company, and more recently with Clark Bros., Co., Inc., division of Dresser Industries.

Named sales director

Appointment of Allen C. Chambers as director of automotive sales of the Bendix Products division of Bendix Aviation Corporation was announced by Malcolm P. Ferguson, vice president and group executive.

Chambers, who has served as Detroit manager of Bendix Products for the past 17 years, will maintain his residence in Detroit and offices both here and in South Bend, it was stated.

He succeeds Frank B. Willis, former director of sales, who will assume full-time management of all Bendix Products war contract terminations and settlements, Ferguson stated. Willis will retain his headquarters at the company's plant in South Bend.

Nation-wide association

A nation-wide association of engineers, embracing all branches of that profession, was advocated recently by C. A. Powel, newly-elected president of the American Institute of Electrical Engineers and international authority on power plant problems.

Speaking before the Los Angeles Section Meeting of the AIEE, Powel declared that "in a world where scientific knowledge and engineering achievement are shaping our habits of thought and life, there is urgent need for an all-inclusive organization that can speak for engineers in the councils of government and the ranks of industry."

Powel, who is manager of headquarters engineering of the Westinghouse Electric and Manufacturing Company, said that such an organization must have "constant and intimate contact with the rank and file of engineers and must bring its weight to bear in community and civic affairs."

Director district 5

E. L. Davis, of Long Beach, California, has been appointed director of the production division in District 5 (Pacific Coast) of the Petroleum Administration for War. He was promoted from within PAW and succeeds Lawrence Vander Leck.

Davis joined the District 5 office of PAW in December, 1941, as chief of the petroleum production section. He was appointed assistant director of the production division in May, 1943. After the resignation of Van Leck in May he served as acting director until his recent appointment as director. Davis was district engineer at Long Beach for The Texas Company at the time he joined PAW.

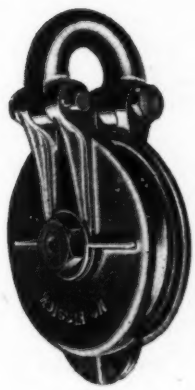
Change in ownership

Hacker Pipe and Supply Company announces a change in ownership. P. M. Pike has purchased the interests of Malleable Iron Fittings Company, J. R. Dickinson, and Mrs. Kathryn B. Hacker.

Dickinson has resigned as president, Pike succeeding him. There will be no change in management or organization. Frank L. Barney is vice president and general manager, B. A. Munn is vice president and manager of sales, and Mrs. Kathryn B. Hacker is a director.

BLOCK SELECTIONS
from the
McKISSICK CATALOGUE

Peerless Snatch Block



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We manufacture all types of blocks—each designed for Safety. Full descriptions are given in Catalog.

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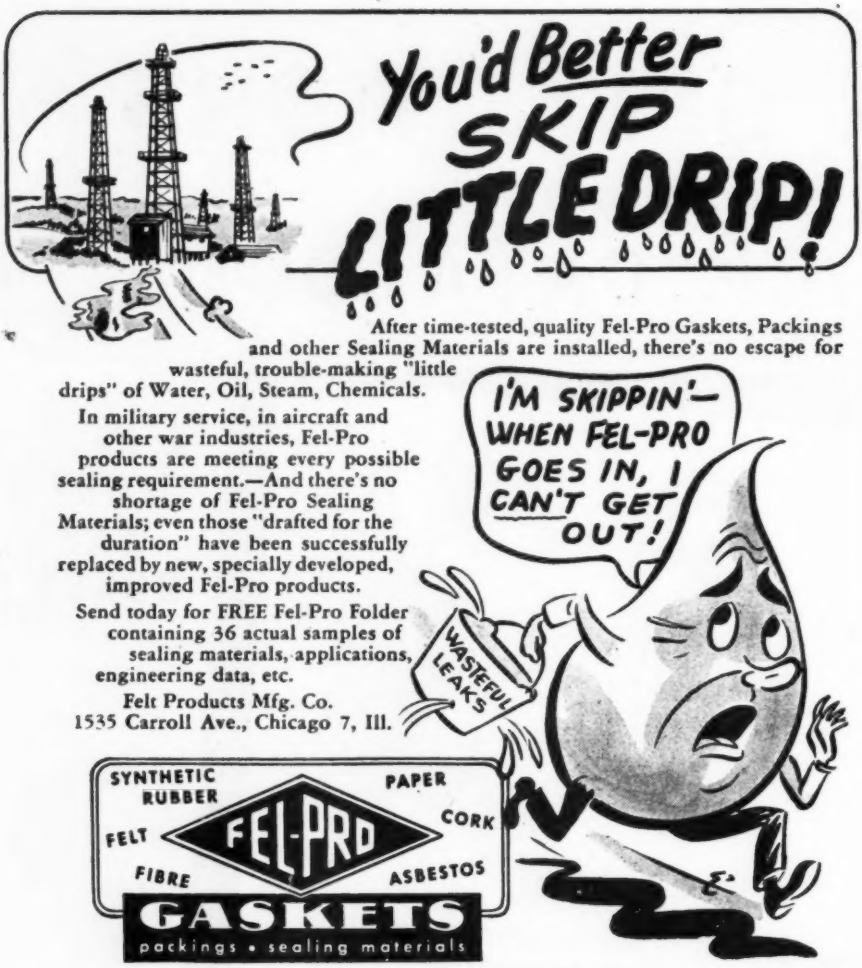

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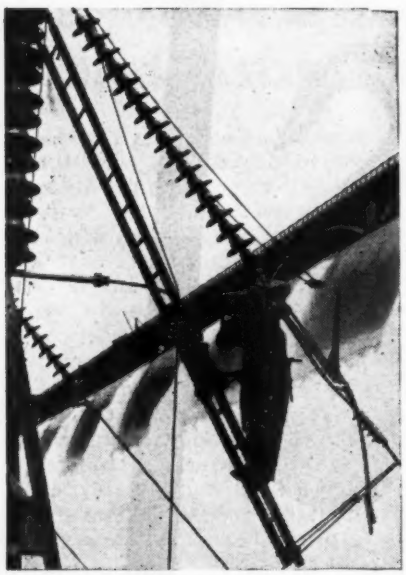

Pictured above is a lineman Ned Ingalls who, with the aid of a Coffing "Safety-Pull" hoist, is man-handling a soon-to-be "hot" wire, as he imitates the "man on the flying trapeze" from his dizzy perch at Grand Coulee Dam.

RATCHET LEVER HOISTS
SPUR GEARED HOISTS
ELECTRIC HOISTS

COFFING HOISTS

We do not claim that Coffing Hoists are the final and perfect achievement, but for 16 years our hoists have been doing their jobs well.

We do claim that Coffing Hoists are the best we know how to build and experience shows them to be generally efficient. (The Army and Navy wouldn't be using them if they weren't.)

We hope that Coffing Hoists are helping to hasten the day of peace—the day our boys can come home again—the day you can call your supplier and say: "Send me a Coffing Hoist"; and your supplier can reply: "Coming right up, brother, we've got 'em in stock."

WRITE TODAY FOR CATALOG No. 000 G-6.

COFFING HOIST COMPANY
Danville, Illinois, U. S. A.

Nomad party success

The largest, and some say the best, party ever put on by the Los Angeles chapter of Nomads was the fifth annual "Wing Ding" held at the Riviera Country Club. Nearly 100 Nomads and guests played in the golf tournament and 286 were at the dinner and the elaborate stage show that climaxed the affair. After finishing the golf tournament and before dinner, games of "skill" were played with phony money, the winnings from these games being used to bid for prizes that, together with the golf prizes, were awarded by an attractive stage and screen actress immediately after dinner had been served.

The winners of the golf prizes, which consisted of merchandise orders for the amounts indicated, were: O. M. Working, $25; Paul Bowen, $15; W. G. Wellington, $10; A. R. Holmund, $10; A. E. Schultz, $10; E. M. Steele, $5.

The game prizes were won by: Capt. Jackman, Major Post, Don Moses, Carl Beal, Roy Dowing, Abe Haglund, Tommy Johnston, Paul Cavins, Roy Dowing, Ox Morgan, and Mr. Aderhold.

The president of the chapter, Roland E. Smith, returned from an extended trip in South America in time for the party, arriving in Los Angeles that morning. The program was ably arranged and executed by a committee consisting of the following: Chairman, Billy McGraw; golf, George Trembley; games, chairman, Jim Robinson, Ray Humphreys, Reed O'Neil, Norman Dorn, Knight Templeton, assisted by guests Ross Wiley and John Shea; prizes and finance, Elmer Smith and Fred Tyler, and stage show, Wally Sawdon, with assistance and offers of assistance too numerous to mention.

Opens district office

Dowell Incorporated announces the opening of an Oklahoma City district office at 1350 National Bank Building. L. A. Courter formerly district manager at Seminole, will be in charge of the new office. Dowell will continue to maintain treating stations and offices at Seminole and El Reno. The Seminole station will be managed by John Mayfield and G. G. "Tiney" McKenney will manage the El Reno station.

Award to Moorlane

The Moorlane Company, Tulsa, Oklahoma, has been awarded the Army Navy "E" for excellence in war production. A ceremony of award will be held September 8 at the Tulsa plant.

Moorlane Company, incorporated in 1929 by W. D. Moorer, president, has been a major sub-contractor on the famous portable pipe-line pump station manufacturing valves, fittings, and special machine work for a number of important war contractors.

In addition to its own business, Moorlane is owner of the Braden Steel Company, of which he also is president.

"Here's why I specify

WHITNEY CHAIN DRIVES"

"Counting on past performance, I know when I get a Whitney Chain, I'm getting a rugged built chain that'll give me plenty of service.

"And there's another kind of service I can count on when I buy Whitney Chains. It's the oil field's top-notch distributor service that's ready to see that I get the stuff I need, *when I need it!*"

You'll find Whitney's alloy-armored steels build extra performance into Whitney Chains. A proven stamina that stands the toughest going . . . takes shocks and overloads . . . and keeps delivering full power to the job.

And you can depend on Continental or Republic for on-the-spot service — whether it's equipment you need or engineering help. The Whitney Chain & Mfg. Co., Hartford 2, Conn.

It pays to specify

WHITNEY CHAINS

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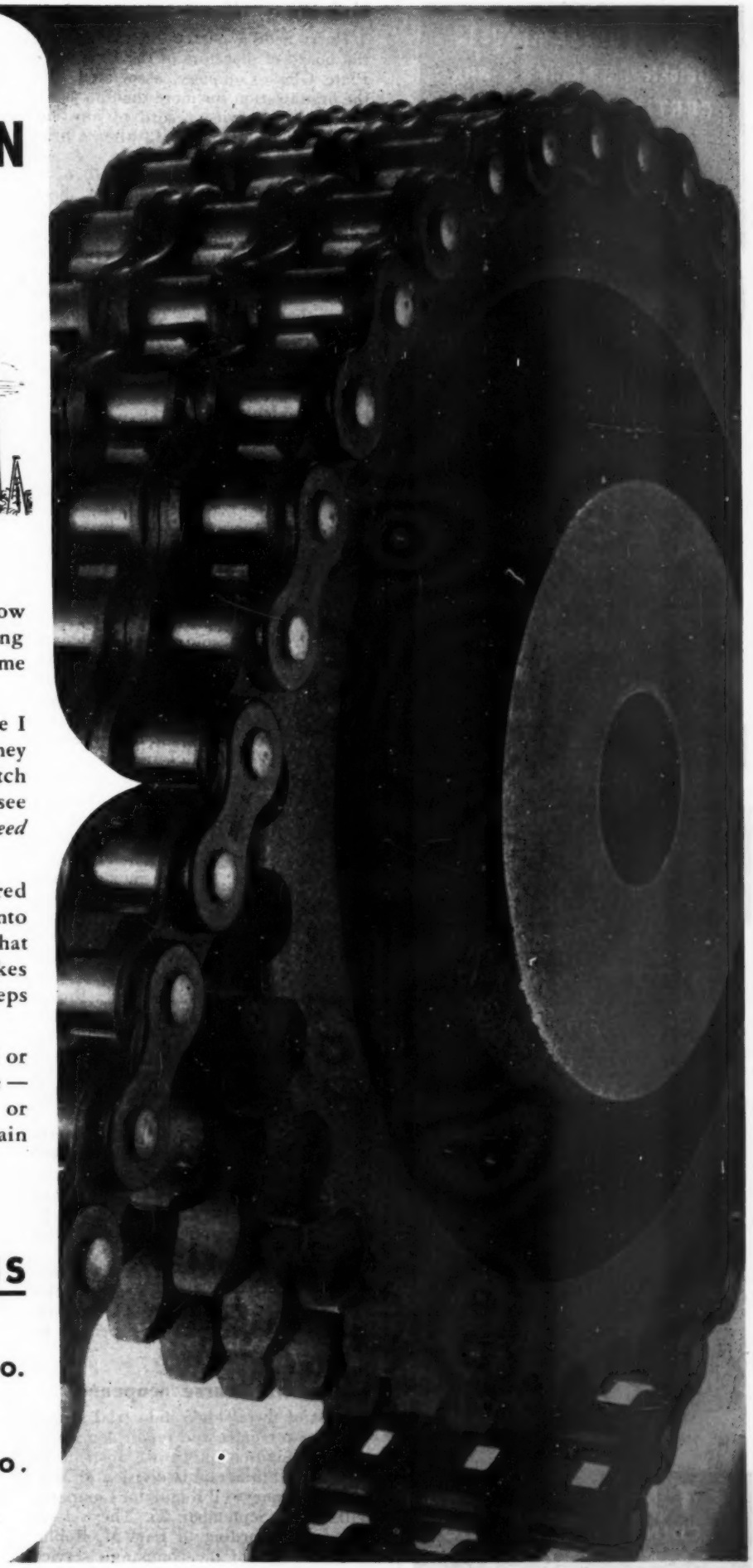

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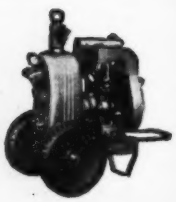

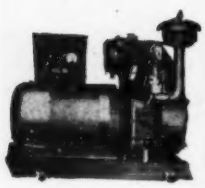

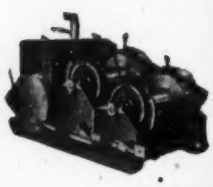

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H. S. Wherrett passes

Harry Scott Wherrett, 68, chairman of the board of directors of the Pittsburgh Plate Glass Company, associated with the organization for more than 53 years, the longest service record of any employee, died on August 13 after a brief illness.

He was born October 24, 1876, in Connorsville, Indiana. Much has been written about his phenomenal rise from office boy to chairman of the board of directors, his many honors, his business connections, and other affiliations.

Among Wherrett's business activities were the following: Bell Telephone Company of Pennsylvania, director; Ditzler Color Company, vice president and director; Mellon National Bank, director; Pittsburgh Corning Corporation, president; Pittsburgh Plate Glass Company, chairman of the board of directors; Southern Alkali Corporation, vice president and director; The Thresher Varnish Company, chairman of the board; Westinghouse Electric and Manufacturing Company, director, and Westinghouse Electric International Company, director.

Dow personnel changes

In the interest of expanded departmental operations, due to the development of many new plastic products, the following personnel changes in The Dow Chemical Company's plastics division are announced by W. R. Dixon, assistant manager of plastics engineering.

At Midland, C. F. Cummins, formerly of the Chicago office, will have charge of plastic engineering activities in molding powders; R. J. Minbiole, formerly of the New York office will handle packaging materials. P. W. Simmons was also transferred from the New York office to handle protective coating materials. F. J. Gunn of the Midland staff assumes the handling of plastic raw materials.

In the New York office, F. L. Brown will have charge of all plastics engineering activities for the eastern territory. Brown was formerly in the Cleveland office. Gage Olcott, recenty with Bolta Company, will join the New York staff, assuming plastic engineering duties.

At Cleveland, E. R. Haines, formerly of the company's St. Louis office, will replace F. L. Brown.

At Chicago, J. E. Russell, formerly of the Midland office, will share with C. R. Webster the duties of the plastics engineering division there.

In the St. Louis office, E. E. Chamberlin, formerly a supervisor of plastics fabrication with Commercial Plastics' Midland branch, will replace E. R. Haines.

Instrument course reopened

First of the 1944-45 industrial instrument maintenance and repair courses of the training school, Brown Instrument Company, Philadelphia division of Minneapolis-Honeywell Regulator Company, will begin September 25. The classes this fall, according to Earl M. Robinson, manager of the company's service division, will be attended to the largest extent by personnel from customer plants. The course will continue until and including December 22.

Classes from September 25 to October 16 will study millivoltmeter type pyrometers. Mechanical potentiometer pyrometers studies and lectures will be held from October 17 to November 1. Continuous balance electronic potentiometer classes will be held from November 2 to 9. Other studies and the periods in which each will be covered are: Electric operated automatic control, November 10 to 20; flow meters, November 21 to 30; thermometers, pressure gauges, and hygrometers, December 1 to 8; air operated automatic control, December 11 to 13, and CO_2, analygraph, resistance thermometers and tachometers for the remainder of the period in the order named.

During the summer the Brown school has been teaching representatives of the military of this and Allied Nations. It has also had a large number of students who have been honorably discharged from the army and navy.

Returns to Hill, Hubbell

Milton M. Bowen, who has been on a leave of absence to serve with the War Production Board, is returning to active duty as vice president and manager of Hill, Hubbell and Company division of General Paint Corporation. Bowen has represented the company since 1936 in the middle west and is thoroughly experienced in all phases of modern steel pipe protection.

California salesman

Baroid Sales Division of National Lead Company announces the appointment of O. C. Slavens as salesman for the Baroid V-belt shock absorber and other specialty products in California.

O. C. Slavens

Slavens comes to Baroid from Lacy Oil Tool Company with which organization he has been associated since 1935. He has worked in the drilling and producing departments of the oil industry since 1921 in both the Mid-Continent and California.

District manager Tube Turns

Chester (Ches) Herndon has been named district manager of the Mid Continent area for Tube Turns, Inc., manufacturers of welding fittings, with offices in the Commerce Building, Houston, Texas. He succeeds W. B. (Bill) Whenthoff, who has established a sales agency in Mexico City where he will represent Tube Turns and manufacturers of allied lines.

Hearndon was formerly associated with the Hanlon-Waters Company of Tulsa. He is a graduate of the University of West Virginia.

Why...you find the "Recalibrator" in the gauge that needs it least—

It would be a wonderful thing if someone would devise a pressure gauge that could take abuse and still remain absolutely accurate.

But every operating man knows that such a gauge has never been made. A sudden surge of over-pressure or some other unexpected shock will knock the best gauge made off the beam. Of course such shocks should be avoided, but unfortunately they just can't be eliminated even in the best regulated plants.

So even the finest gauge of them all — even the Marsh Mastergauge, for example — may at sometime go out of adjustment. What then?

Well . . . if it were the conventional type of gauge you would have to laboriously remove the pointer, glass ring and dial, and reset the movement adjustment. But when a Marsh Gauge is out of adjustment it's only a passing incident. You simply turn the "Recalibrator" screw until the pointer goes to the zero mark, and this can be done in less time than it takes to tell it.

The "Recalibrator" is not only the *handy* way to correct the error; it's also the *best* way. Practically all errors in gauges are caused by distortion of the bourdon tube. This distortion produces an incorrect relation between the tip of the tube and the movement. When you reset the pointer, you don't correct this relationship; you simply compensate for it. As a result the gauge may be corrected at the zero point but be incorrect at certain other points on the dial.

The "Recalibrator" actually re-establishes the relation of the tube to the movement. Therefore it actually *does* "re-calibrate" the gauge.

When you stop to think it over, it's perfectly logical that the "Recalibrator" should be found on the gauge that needs it least. The manufacturer who takes the most pains to build a gauge that *is* accurate would naturally be the manufacturer to provide the best means of *keeping* it accurate!

NEW BRANCH ASSEMBLY AND REPAIR PLANT AT

HOUSTON

To meet the ever-increasing demand for Marsh equipment and service in the oil country we have opened a branch assembly and repair plant at Houston, Texas. The facilities of this plant will not only expedite the handling of your requirements; it also enables us to render a complete engineering service and provides ideal facilities for servicing and repairing all makes of gauges.

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"THE STANDARD OF ACCURACY"

DIAL THERMOMETERS HEATING SPECIALTIES

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"The Entirely Different Boiler and Engine Treatment"

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That Boilers and Tubes be free from scale and corrosion—

Free to produce maximum power at minimum cost with longer life.

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Look for the Arm-and-Hammer

ARMSTRONG BROS. CHAIN TONGS

ARMSTRONG BROS. CHAIN TONGS have been engineered to overcome the weaknesses discovered in ordinary tongs. They are stronger, last longer and are more convenient.

Jaws are drop forged, with milled teeth, are heat-treated and extremely tough. They have inner lugs which increase the bearing on the bar and also prevent chains from jamming. Other strength features include forged handles, large hardened steel bolts, alloy steel shackles and proof-tested chains.

ARMSTRONG BROS. Tongs come in *all* standard types, each in *all* sizes.

Write for Catalog.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
331 N. FRANCISCO AVE. CHICAGO, U.S.A.
Eastern Warehouse & Sales, 199 Lafayette St., New York

Ransome appointments

The Ransome Machinery Company, subsidiary of Worthington Pump and Machinery Corporation, Dunellen, New Jersey, announces the appointment of the following organizations as distributors of the Ransome line of welding positioning equipment:

The Post Welding Supply Company, Birmingham, Alabama; Hobart Welder Sales and Service, Cleveland, Ohio; W. P. & R. S. Mars Company, Duluth, Minnesota; American Machinery and Supply Company, Omaha, Nebraska; Arcway Equipment Company, Pittsburgh and Philadelphia, Pennsylvania, Baltimore, Maryland, and Richmond, Virgina; Hobart Sales Service Supplies, Buffalo and Syracuse, New York; Peoria Welding Supply Company, Peoria, Illinois; Big Three Welding Equipment Company, San Antonio, Corpus Christi, Dallas, Houston, and Fort Worth, Texas; Moline Welding Service, Moline, Illinois; Chicago Welding Sales Company, Chicago, Illinois; Victor Equipment Company, San Francisco, Fresno, Los Angeles, and San Diego, California; Austin-Hastings Company, Inc., Cambridge and Worcester, Massachusetts, and Hartford, Connecticut; J. E. Raney and Company, Boston, Massachusetts, and Welding Engineering and Sales Company, New York City, Buffalo, and Syracuse, New York.

Adds to sales force

The Foxboro Company announces the addition of Paul Torre to the staff of sales engineers covering the New England territory.

Torre brings to his new work a background of useful experience covering nearly 25 years, many of them devoted to technology and production control, especially in pulp and paper mills. His headquarters will be at the New England district office of The Foxboro Company, at Foxboro, Massachusetts.

Receives second star

A second star for their Army-Navy "E" production award burgee was recently received by the Maxim Silencer Company in Hartford, Connecticut. The award was made by Lt. Commander R. W. Rose, USNR.

The original award was made in the middle of 1943 and the first star added 6 months later. Maxim Silencers are in wide use today on Diesel powered craft in the navy, coast guard, and merchant marine.

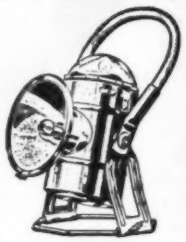
Export manager

The Jas. P. Marsh Corporation, Chicago, Illinois, recently announced the appointment of R. S. Gaisford as manager of the Marsh export department at 155 East 44th Street, New York City. During the many years in which Gaisford has been eastern division manager of the organization he has developed a wide circle of friends.

POWERFUL BEAM . .
or Bright
FLOODLIGHT
WHEN YOU CARRY

ECOLITE 72

This is a safe, efficient economical lantern that gives you a strong 1500 ft. beam or a bright floodlight. It is easy to carry, tilts and pivots, gives you lots of light where needed. Carries Underwriters' Laboratories recommendation for use in Class 1 Group D Hazards. Low price. See it at once. At Oil Well Supply Stores.



ECONOMY ELECTRIC LANTERN CO.
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Petroleum or Mechanical Engineer with several years field experience in well completion and production preferably in the Gulf Coast area to promote sales of technical oil field services and equipment. Permanent position with good future for man with imagination, initiative, and genuine interest in sales engineering. Give full details of education, experience, and availability in first letter. All replies held confidential. Box 18, % The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

Look to foreign operations

Fowler McCormick, president of the International Harvester Company, has announced the formation of a new foreign operations organization that will be in charge of all foreign activities of the company except Canadian operations. The International Harvester foreign operations organization will be headed by G. C. Hoyt as vice president, who heretofore has been vice president in charge of foreign sales.

C. N. King, formerly manager of foreign sales, becomes director of foreign operations in the new set-up.

A. M. Rode, formerly European comptroller and assistant treasurer of the company, has been appointed to the newly created position of director-general of European operations, and will have charge of all European activities.

J. L. Camp, formerly an executive of the International Harvester Company Argentina, has been appointed director-general of Latin-American operations.

King will be assisted by an executive staff of specialists, who will be designated as managers of foreign manufacturing, sales, engineering, accounting, supply and inventory, merchandising services, and treasury. These executives will be at the general offices in Chicago.

There will be no change in the status of the company's various foreign subsidiaries.

Because of the large rehabilitation job that will be faced in Europe after the war in re-establishing the company's business, and the large scale of its operations there, Rode will reside in Europe after the war. All the other top executives in the new foreign organization will be at the Chicago offices.

Research project

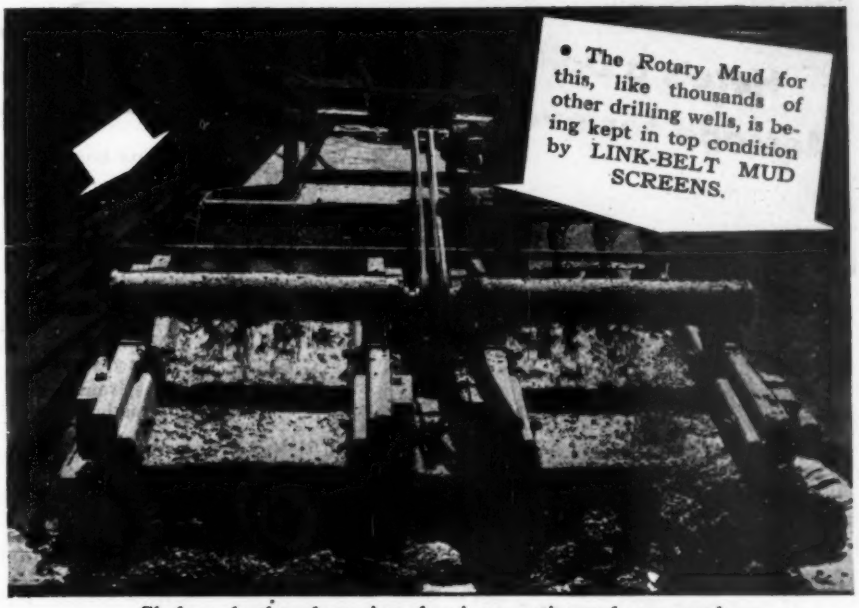
The University of Oklahoma, Norman, Oklahoma, is undertaking a research project on the drying of gases by activated alumina, from a chemical engineering point of view. The investigation, which is financially supported by the Aluminum Company of America, is under the direction of Dr. R. L. Huntington, chairman of the school of chemical engineering. He will have the part-time assistance of professors G. F. Russell and F. F. Blankenship.

Kerotest award

The United States Maritime Commission has awarded Kerotest Manufacturing Company a fourth gold star to add to its Maritime "M" Pennant, symbolizing the renewal of the "M" award for an additional 6 months' period. This new honor makes the fifth award to Kerotest from the Maritime Commission for excellence in production of equipment for the Victory Fleet Program.

Second star

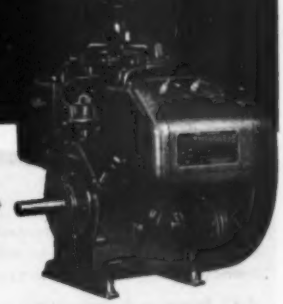
Admiral C. C. Bloch, USN (Ret.), chairman of the navy board for production awards, has informed The Foxboro Company, Foxboro, Massachusetts, of its second renewal of the Army-Navy "E" Award "for meritorious service on the production front."



Shale and other damaging abrasives continuously removed.
LINK-BELT COMPANY, Philadelphia 40, Houston 2, Dallas 1, Los Angeles 33, New York 7, Toronto 8. Sold by most supply houses 9271

LINK-BELT MUD SCREEN

All WISCONSIN HEAVY-DUTY Air-Cooled ENGINES are equipped with EXTENDED SHAFT for Power Drive



You have no outboard bearing problem in rigging up a power take-off when the power unit is a Wisconsin Air-Cooled Engine.

All Wisconsin Air-Cooled Engines are equipped with an extended shaft, which is an integral part of the crankshaft proper. Drive pulley, sprocket, gear drive or direct-connected coupling can be attached directly to this extended crankshaft . . . because all Wisconsin Air-Cooled Engines are equipped with *tapered* Roller Bearings at both ends of the crankshaft to take up end-thrust and carry the power load.

This is a feature frequently overlooked by the purchaser of an engine . . . but it is NOT overlooked in the manufacture of Wisconsin Engines . . . built for efficiency and dependable service in *all* ways.

Most H.P. per pound

WISCONSIN MOTOR Corporation
MILWAUKEE 14 WISCONSIN U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
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OIL FIELD DISTRIBUTOR FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS

Here's a Dollar-and-cents Message for every pump user!

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ESTABLISHED 1879
REFINERS OF PENNSYLVANIA CRUDE
FREEDOM, PA.

November 1, 1943

Darling Valve & Manufacturing Company
Williamsport, Pennsylvania

Gentlemen:

Here's a performance report on Darcova Pumcups taken from our maintenance records. It should interest you as much as it did us.

Equipment: Worthington duplex steam pump, 12 x 5 x 12 with cast iron insert liner.

Service: Crude oil unit charging, 250-275# pressure, atmospheric temperature, corrosive service.

Average previous performance using cast iron rings:

Rings - 15 days
Pistons - 30 days
Liners - 30 days to 60 days
Rods - varying lengths of time, 30 to 90

Performance using Darcova-designed pistons and Darcova Pumcups:

Installed: September 4, 1942 along with 6" seamless steel liner, metal sprayed with hard stainless steel I.D. ground finish.

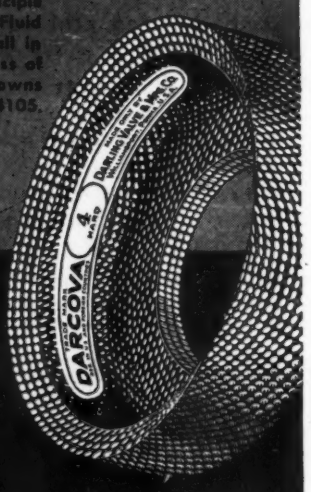
Pistons and Pumcups are still in service today, nearly 14 months later, with original liners, pistons, rods, and packing still operating. Pump efficiency increased over 25%.

Yours very truly,
Ross McClain
Ross McClain,
Master Mechanic

RM/EH

For over forty years Darcova has been helping pump operators to save time and money and to set operating records like this.

With Darcova Pumcups the cup principle insures constant pumping efficiency. Fluid pressure keeps the Pumcup sidewall in close contact with the liner, regardless of wear. Efficiency is increased, shutdowns are fewer. Send for Bulletin No. 4105.



DARCOVA
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING COMPANY
WILLIAMSPORT, PA.

Book Reviews

▼ **Combustion-Chamber Design for Oil Engines,** *by Paul Belyavin. Published by Sherwood Press, Box 552, Edgewater Branch, Cleveland, Ohio. Pages, 87. Price, $1.50....* A critical survey of the problems of efficient oil engine design, a study of oil engine history, and the principles essential to know when designing a combustion chamber, are discussed in this volume. Drawings, specifications, and graphs clarify the subject.

▼ **Aviation Gasoline Manufacture,** *by Matthew Van Winkle. Published by McGraw-Hill Company, 330 West 42nd Street, New York. Pages, 275. Price, $3....* One of the mineral industries series of The Pennsylvania State College, this volume summarizes the available information concerning the manufacture of aviation gasoline in such a form that it will serve as a reference for those who are interested in this field of refining. Detailed information of new processes cannot be described at this time with the nation at war. History of the development of aviation gasoline, of its production, its components, and its performance are included in some detail.

▼ **Salvage Manual for Industry,** *edited by a board composed of members of industry and the business press. Published by Technical Service Section, Industrial Salvage Branch, War Production Board. Pages, 243. Price, 50c, direct from Superintendent of Documents, Washington, D. C....* A practical manual on industrial salvage, this book can be helpful in the present war economy and may contribute to more efficient management of postwar salvage projects.

▼ **Emulsion Technology.** *A symposium. Chemical Publishing Co., Inc., 234 King Street, Brooklyn, N. Y. Pages, 290. Price, $5....* Many specialists in various lines of industry and science have contributed to this timely and practical symposium. It covers the theory and use of emulsions and emulsifiers in agriculture, road-making, food, rubber, leather, wool, paint, and varnish and in other industries. Valuable data concerning the equipment and techniques in the manufacture of emulsions are included.

▼ **Practical Design of Welded Steel Structures** *by H. Malcolm Priest. American Welding Society, 33 West 39th Street, New York 18, N. Y. Pages, 150. Price, $1....* A practical working manual designed to set forth the essentials of welding and welded construction with clarity and conciseness, this book is of special interest to engineers and fabricators. It includes brief, yet adequate, discussions of the various welding processes, specifications for electrodes, types of welds, welding positions, qualification tests and inspection, and a number of charts.

▼ **Manual of A.S.T.M. Standards of Refractory Materials.** *American Society for Testing Materials, 260 S. Broad Street, Philadelphia, Pennsylvania. Pages, 210. Price, $1.50....* Of particular value to those who use refractories is this fifth manual of A.S.T.M. Standards on Refractory Materials. The publication gives new standards for air setting refractory mortars, fireclay plastic refractories both for boiler and incinerator services, methods of test for measuring the shrinkage, spalling, and workability index of fireclay plastic refractories, and a method for measuring the thermal conductivity of insulating fire brick. It also has included a group of industrial surveys describing the operations carried out in the furnaces, the types of refractories used in them, and outlines the conditions that affect the life of the refractories.

▼ **The Engineer's Manual of English** *by W. O. Sypherd, Alvin M. Fountain, and Sharon Brown. Scott, Foresman and Company, Chicago. Pages, 500. Price, $2.50....* The Engineer's Manual of English is revised from the 1933 edition to include more material and to replace dated illustrations or specimens with current examples. It is designed to serve as a textbook in English compositions for college students in engineering and as a reference book on usage in technical writing for practicing engineers.

▼ **Handbook of Plastics** *by Herbert R. Simonds and Carleton Ellis. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. Pages, 1080. Price, $10....* Designed to present exhaustively and yet with proper selection the fundamental basis and technology of the plastic industry, this handbook contains nine sections covering the industry today. It tells of the physical and chemical properties of plastics, their production, manufacture, and finishing, and includes full information on the subject of plastics both for professional and novice in the field.

Love district manager

W. Wray Love has recently assumed new duties as district manager of Dowell Incorporated's Salem, Illinois, district. He has been associated with Dowell, a wholly owned subsidiary of The Dow Chemical Company, since 1934 and has worked in nearly every area in which Dowell operates including Alberta, Canada. For the last several years he has been district engineer at Salem and assumes his new position with a background of wide experience in the Salem district, which includes Illinois, Kentucky, and Indiana.

Love holds a Ph. D. degree in geology from the University of Illinois, and prior to joining Dowell 10 years ago, gained extensive experience in all phases of the oil industry in many oil producing areas, including South America. Dr. Love replaces J. H. Courtner who has taken on new duties in connection with Dowell's expanding industrial chemical division, which offers a complete service for the chemical removal of scales and sludges from heat exchange equipment.

Exclusive representative

Republic Flow Meters Company, Chicago, Illinois, announces the appointment of Merrill Berkley as its exclusive representative in southern California and parts of Nevada and Arizona. Berkley, who graduated from the California Institute of Technology at Pasadena, with a degree in mechanical engineering, has transferred from Republic's Chicago headquarters and will handle sales and application engineering and equipment service for Republic and allied manufacturers. He has held positions as heating and gas sales engineer with Autogas Corporation, Republic Heaters Company, Missouri Natural Gas Company, and the former Los Angeles Gas and Electric Company. He has been associated with Republic and subsidiary companies for 8 years on application engineering and field supervision of Republic instruments and combustion and process controls.

Berkley's office is in the Lincoln Building, 742 South Hill Street, Los Angeles 14, California.

To university staff

Dr. R. L. Huntington, chairman of the school of chemical engineering at the University of Oklahoma, announces the recent appointment of George F. Russell as assistant professor on the chemical engineering staff.

Russell has been connected with the Phillips Petroleum Company in their natural gasoline division for a period of 5 years and has done considerable research on problems pertaining to fractionation of petroleum and the dehydration of natural gas. At present he is continuing research in these two engineering fields.

Byron Jackson representatives

Byron Jackson Company, Los Angeles, California, has appointed Joel B. "Buck" Buchanan to the Rocky Mountain territory for the oil tool division of the company with headquarters in Casper, Wyoming. Buchanan has had 20 years' oil field experience in the Mid-Continent and foreign fields, including Mexico and South America as a contractor, tool pusher, and rig man. Before leaving for Casper, Buchanan underwent an extensive training program on the entire line of BJ tools at the oil tool division.

Lawrence M. "Larry" Coker has also joined the BJ oil tool division as export sales engineer and will handle foreign contracts on the Pacific Coast. Coker was connected for a number of years with National Supply Company where he engaged in similar duties.

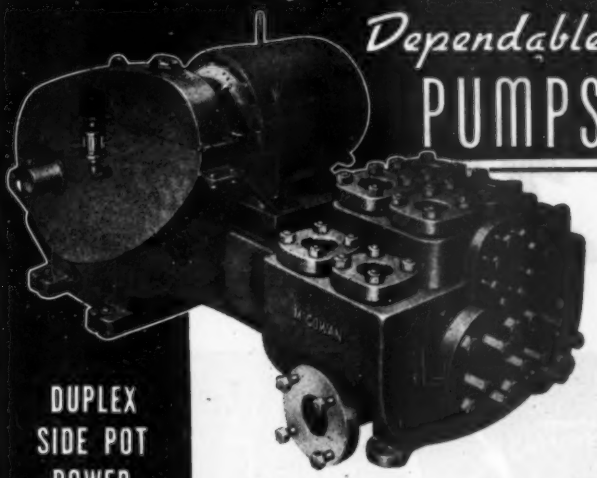
Brown Army-Navy "E"

Employees were given the entire spotlight and all honors in the official acceptance by them for the Brown Instrument Company, Philadelphia, precision industrial instrument division of Minneapolis-Honeywell Regulator Company, of the third Army-Navy "E" Award for war production excellency. Ceremonies took place August 15.

The company decided, said E. B. Evleth, vice president and general manager of the Brown company, to grant to the workers all the honors that have twice before been shared by the military and Brown officials and executives.

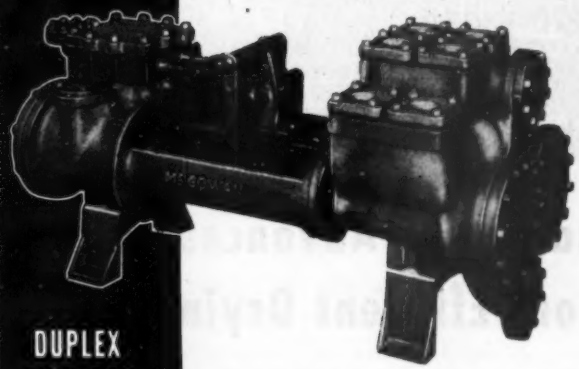
DESIGNED by McGOWAN

Dependable PUMPS



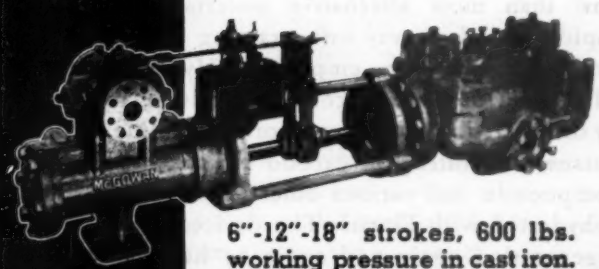
DUPLEX SIDE POT POWER PUMP

For heavy duty pipe line service. 6"-10"-12" strokes. Pressures up to 1500 lbs. Herringbone gears, Timken roller bearings.



DUPLEX SIDE POT STEAM PUMP

For Refinery service with trim to suit. Also available with waterjacketed stuffing boxes 6"-10"-12" strokes.



CLOSE CLEARANCE PUMP

6"-12"-18" strokes, 600 lbs. working pressure in cast iron. Metal covered gaskets, ample studding, water jacketed stuffing boxes, available with trim to suit.

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New York	MUrryhil 2-0796	Tulsa	5-2151
Philadelphia	LOmbard 0787	Cleveland	Liberty 2142
Houston	FAirfax 8089	Detroit	MAdison 1575
Los Angeles	VAndk. 1358	Charleston	37-606
New Orleans	CAnal 4851	Salt Lake City	3-4682
San Francisco	EXbrook 1188		

McGOWAN PUMPS

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HYDROFLUORIC ALKYLATION
For Aviation Gasoline

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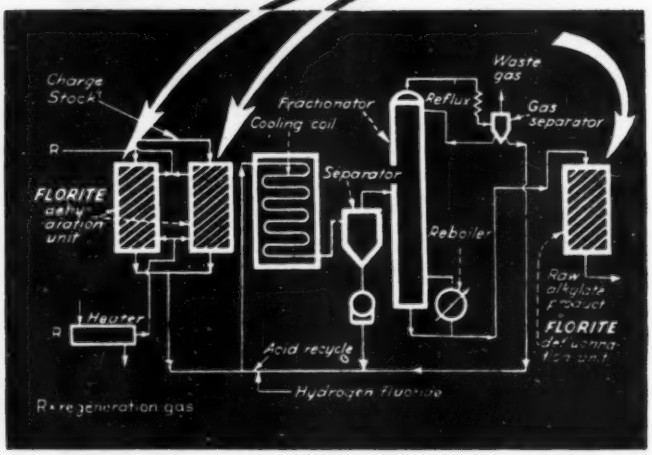

Industrial Advances call for More Efficient Drying Agents

Equal or superior to other granular desiccants in drying efficiency and general performance, more economical in use because of longer life under the conditions of service involved, and lower in initial cost than most alternative materials, Florite* has rapidly found its way into exacting processes where drying agents are employed. Hydrofluoric Acid Alkylation of light petroleum fractions, represented by the chart above, is a noteworthy example. Propane, butane, air, nitrogen, carbon dioxide, refrigeration compounds, and various other fluids are successfully dehydrated with Florite. The desiccant is capable of regeneration again and again by heating to 350°F.

Made from bauxite by special processes of activation and mechanical adaptation, Florite uses no highly critical wartime materials and is therefore fully available for any users' requirements. Correspondence is invited.

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ADSORBENTS

Room 54, 220 Liberty Street — Warren, Pa.

TRADE LITERATURE

Publications listed are sent free upon request.

▼ The Worthington Pump and Machinery Corporation, Harrison, New Jersey, has released a group of bulletins, which are now available for distribution. They are "Worthington BB Diesel Engines," "Refrigerant Condensers," "Chilling Machines and Exchangers," and "Equipment for Process Industries."

▼ An illustrated 48-page booklet on the problem of selecting the proper bucket to meet the operating requirements when single drum hoists and hook-on applications are involved, has just been released by the Blaw-Knox Company. Catalog No. 2002 is divided into four parts: Selection, typical method of installation, table of sizes, and typical illustrations. It may be secured by writing to Blaw-Knox Company, P. O. Box No. 1198, Pittsburgh, Pennsylvania.

▼ The current issue of "The Eutetic Welder" published by the Eutetic Welding Alloys Company, discusses ways to prevent metals that are to be heat-treated from tarnishing. There are various methods used for this, and the booklet discusses each one in turn. The booklet may be had by writing the company at 40 Worth Street, New York 13, New York.

▼ The latest issue of "H-O-H Lighthouse" published by D. W. Haering and Company, Inc., of Chicago, Illinois, contains interesting and valuable material, with illustrations, on the application of scale and corrosion to the oil industry. Featured in the issue is the story of The Texas Company's achievements in drilling for oil on water; and the work of the Cleveland Tankers, Inc. in transporting oil on the Great Lakes in order to keep the fuel oil moving to war plants and aviation gasoline to airplane plants and air fields.

▼ As the first producer of "Silicones," the new heat stable, organosilicon oxide polymers, Dow Corning has issued a booklet describing the temperature stability, inertness, waterproof quality, and dielectric properties of their various products. It also lists insulation constructions requiring heat stable resinous dielectrics, together with samples of insulations made with Dow Corning Silicone Resins. The booklet may be secured by writing Dow Corning Corporation, Box 592, Midland, Michigan.

▼ Owens-Corning Fiberglas Corporation has issued a booklet explaining characteristics and various uses of Fiberglas tower packing. Fiberglas, because it will not absorb moisture, will not rot or decay, provides no sustenance for insects, vermin or fungi, remains unchanged by time, and is resistant to most chemicals, has been wisely acclaimed by the petroleum, chemical, and distillery industries. Copies may be obtained by addressing the company, Toledo 1, Ohio.

▼ A concisely recorded and graphically illustrated brochure has been published by Clark Brothers Company, Inc., describing the 2-cycle engine that "came up the hard way." The Clark Company developed the first engine embodying the 2-cycle principle in an effort to eliminate the "waste stroke" in 4-cycle operation. The story of this development is told in the new booklet, obtained from Clark Brothers Company, Inc., Olean, New York.

▼ The current issue of Drilling Mud, published by the Baroid Sales Division, National Lead Company, 830 Ducommun St., Los Angeles, California, explains the various uses of Impermex in drilling muds. The discussion is divided into its various features—minimum water loss of drilling mud provided by Impermex, general recommended methods for use of Impermex, etc.

▼ The thirty-ninth edition of the Kueffel and Esser Company general catalog, intended as an interim publication for the duration, covers all instruments and materials now being manufactured. Separate pamphlets are available covering surveying instruments and equipment. A copy of the catalog may be had by writing Keuffel and Esser Company, Hoboken, New Jersey.

▼ The American Pipe and Construction Company has just issued a new catalog on Amercoat Plastic Coatings describing the proved uses of the product. A number of organic and inorganic materials, foods and beverages and actual equipment and structures are now being protected against corrosion or contamination by Amercoat. Copies may be obtained by writing Amercoat Division, American Pipe and Construction Company, Box 3428 Terminal Annex, Los Angeles 54, California.

▼ A catalog and data book on self-locking nuts, virtually an engineering handbook, has been issued by the Elastic Stop Nut Corporation of America. It covers the hex, anchor, and clinch types of nuts, and contains numerous tables of illustrations. It is available to all users of fasteners from the Elastic Stop Nut Corporation, Union, New Jersey.

Joins H. C. Price Company

H. C. Price Company announces the appointment of James P. Neill as general superintendent of the pipe-line construction division. Neill has been with the Southern Natural Gas Company of Birmingham, Alabama, for the last 15 years and, since 1936 has held the position of superintendent of pipe lines for that company. He will make his headquarters in Bartlesville, Oklahoma, and will assume his new duties October 1.

Mason to National Tube

Louis W. Mason, formerly purchasing agent of the Tubular Alloy Steel Corporation in Gary, Indiana, has been appointed assistant to general manager of sales of the National Tube Company, another U. S. Steel subsidiary, it is announced. Mason will make his headquarters in Washington, D. C.

Pomona pump company sold

Fairbanks, Morse and Company has purchased the Pomona Pump Company, a division of Joshua Hendy Iron Works, in a $4,000,000 transaction.

Announcements of the sale were made simultaneously in Chicago by R. H. Morse, Jr., general sales manager of Fairbanks-Morse, and in Sunnyvale, California, by Charles E. Moore, president of the Joshua Hendy Company. The sale was effective as of September 2.

All physical assets, patents, and trade marks of the Pomona and Westco pump lines were included in the transaction. The Pomona firm has plants in Pomona, California, and St. Louis.

No changes in personnel are contemplated and, according to Morse, Arnold G. Brown, general sales manager of the Pomona Company, becomes assistant manager of the Fairbanks-Morse Pump Division in charge of Pomona and Westco products. Distribution and sales will continue under Brown's direction.

Morse pointed out that acquisition of the Pomona Company will augment the Fairbanks-Morse line of pumps, and that this is an addition to the Fairbanks-Morse pumps now being manufactured.

Hereafter the Pomona pumps will be known as Fairbanks-Morse-Pomona, and Fairbanks-Morse-Westco line.

Opens office and warehouse

The Guiberson Corporation formally opened its sales office and warehouse at 4414 South Main Street in Houston, Texas, September 2.

Glen T. Thornton is manager of the office and warehouse. Don Brock and Don Whittenberg, service engineers, will cover the territory served by the Houston warehouse.

Eagle Picher appointments

J. M. Bowlby, president of The Eagle-Picher Lead Company, announced the retirement of George W. Potter, director, executive vice president, and general manager of the company's subsidiary, The Eagle-Picher Mining and Smelting Company, and of G. C. Niday, Tri-State manager of mines and mills. Potter and Niday are retiring to devote their attention to other non-competitive personal interests, in which they have been associated for many years.

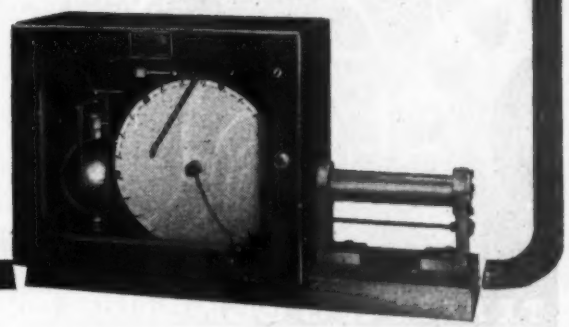
At a regular meeting of the board of directors of The Eagle-Picher Mining and Smelting Company, Bowlby was designated general manager, in addition to his present duties as president. He will be assisted in the direction of the company's activities by D. C. MacKallor, Hamilton A. Gray, and Elmer Isern, who have long been associated with the company in executive capacities. At the board meeting, MacKallor was elected a director and MacKallor, Gray, and Isern were elected vice presidents.

Bowlby also announced appointment of R. L. Hallows as technical assistant to the president of The Eagle-Picher Lead Company and production manager of the pigment division of that company. Hallows' most recent assignment was as superintendent of smelters of the subsidiary.

Why Major Company Engineers Select

ARCCO LIQUID GRAVITOMETERS

for Determining SPECIFIC GRAVITY OF HIGHLY VOLATILE LIQUIDS



1—OPERATES UNDER ACTUAL LINE PRESSURE. High working pressure prevents release of gas—an extremely important feature in measuring specific gravity of highly volatile liquids.

2—AUTOMATIC TEMPERATURE COMPENSATION. Produces highly accurate and fully corrected record of specific gravity of liquid under any designated standard temperature conditions.

3—CONTINUOUSLY FLOWING SAMPLE. Changes in specific gravity shown with minimum time lag. Pressure necessary to produce required flow is only a few pounds per square inch, except for very viscous liquids.

4—NO MOVING JOINTS OR STUFFING BOXES. Friction and leakage eliminated. Instrument is delicately responsive to minute changes in specific gravity.

5—INDICATING AND RECORDING TYPES. Either type available with automatic temperature compensation. Can also be made of non-corrosive materials.

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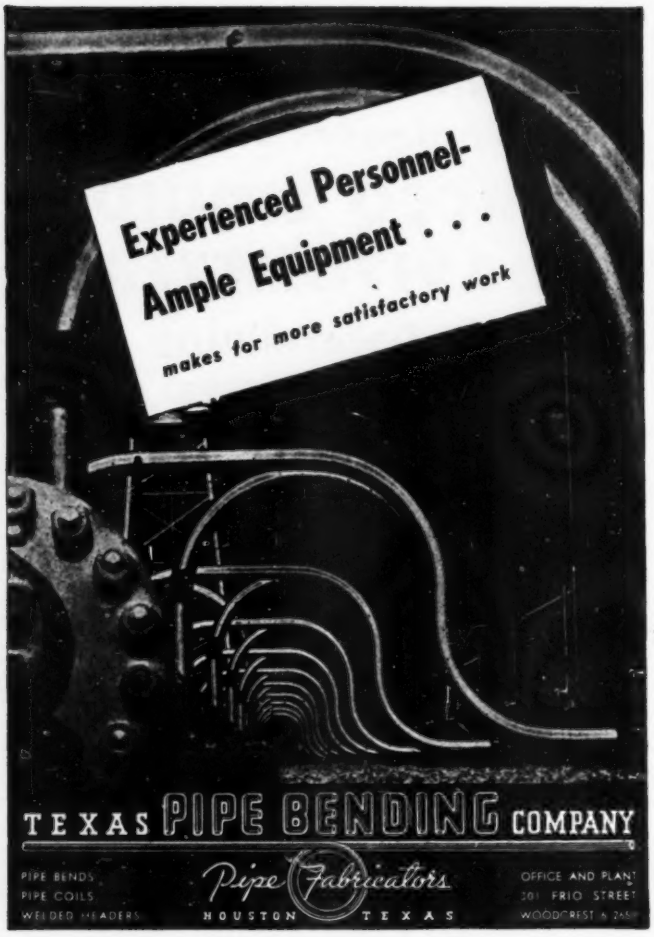

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Heat and corrosion resisting metals and high strength alloy steels.

Alloy steel studs and bolts for high pressure piping stocked for immediate shipment.

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Socony-Vacuum president dies

John A. Brown

John A. Brown, 59, president of the Socony-Vacuum Oil Company, died in Montreal, Canada, September 8. He entered the oil business in 1911 as secretary-treasurer of a small oil company in Taft, California. Later he went to Mexico and the Dutch East Indies where he spent eleven years as an official of the Standard Oil Company of New Jersey. He has served as both vice president and president of the General Petroleum Corporation in Los Angeles, and in 1933 went to New York as head of the Socony-Vacuum Oil Company, Inc., formed in 1931 when Standard and Vacuum Oil Company merged.

Joins M. F. Hampton

M. F. Hampton and Company, pipe line and oil field equipment sales company, announces the entrance of Allen J. Edwards into the firm as a co-partner. Edwards, for 18 years with Black, Sivalls and Bryson, and 12 years as sales manager of the company, brings to the Hampton firm a world-wide acquaintance in the petroleum industry and a broad experience in the equipment business.

Hampton is a pioneer in the pipe line and oil field equipment business, and has been operating his own business for several years. Before joining B. S. & B., he was purchasing agent for the former Oklahoma Power Company, during which time he served as vice president of the Purchasing Agents Association of Tulsa.

The new firm will specialize in pumps, engines, half soles, welding sleeves, river crossing clamps, and other pipe line equipment. It announces a program of expansion, including additional lines, broader territory, and warehouse facilities. The company has established new and enlarged offices in the McBirney Building, Tulsa, Oklahoma.

Veterans training program

Preparing vocationally handicapped veterans for postwar jobs passed from the plan stage into action recently as The Cooper-Bessemer Corporation became the first among the thousands of industrial companies in Ohio to inaugurate an apprentice training program in cooperation with the rehabilitation division of the veterans administration.

A group of veterans has already begun the course at Cooper-Bessemer's Mt. Vernon, Ohio, plant, according to Steven Hurtuk, chief of the training division at the U. S. Veterans Administration Hospital at Brecksville, Ohio, and it is said that the company will start additional apprentice groups in the near future as discharged soldiers with accredited aptitudes become available.

Cooper-Bessemer's apprentice training program has been developed over a period of many years with such success that virtually the same plan has been adopted, for application to other industries, by the federal committee on apprenticeship of the U. S. Department of Labor.

This four-year apprenticeship course calls for 8232 hr. of shop work and 768 hr. of related class-room instruction, under the supervision of capable instructors who will devote their full time to this work. Those completing the course will receive from the state a "certificate of completion" to give evidence that they qualify as full-fledged machinists. It is also customary for Cooper-Bessemer to present each man with a $100 bonus and to give him a job at journeyman's wages.

In addition to the instructors who will train the discharged veterans, Cooper-Bessemer's course is supervised by an apprenticeship committee consisting of three labor representatives and three management representatives assisted by the Mt. Vernon superintendent of schools as an ex-officio member of the committee.

The veterans will receive standard apprentice pay from Cooper-Bessemer. In addition, each man will receive from the government a monthly maintenance allowance so that his income will approximate that of a journeyman machinist's.

EXPERIENCE BUILDING OIL TOOLS SINCE 1882

NORRIS

TUBING

The Norris Tubing Eliminator

SAVES TUBING COSTS — CUTS MAINTENANCE

An operator in Kansas, reports a saving of $16,275.00 on fifteen wells by using the Eliminators. Average depth of wells 3,300 feet. This same company reports further savings of $40.00 per well, each time it was necessary to pull the well. On deeper wells, saving is proportionately greater.

Similar savings are reported by many major and independent oil companies after rigid tests made under varying field conditions. Reports from producers who are using NORRIS Tubing Eliminators, indicate they are being accepted as Standard Equipment.

When a NORRIS Tubing Eliminator is installed, you have only a rod job to service the well — NO wet string of tubing to pull. Well casing remains full of fluid at all times and when pump is serviced and put on beam it will immediately start fluid to tanks.

GUARANTEED — Behind each NORRIS Tubing Eliminator stands the NORRIS Label of Quality, known and accepted throughout the oil world as the symbol of finest material and workmanship. NORRIS standards assure that the best quality will be present in each Tubing Eliminator bearing the NORRIS Label. The company guarantees Quality Manufacturing — both as to materials and workmanship.

For complete information about this revolutionary forward step in oil production — SEND FOR BULLETIN NO. 34

JAY TOOL TYPE, illustrated in set position with seating nipples to use in connection with insert type pump.

THE NORRIS TUBING ELIMINATOR CAN BE INSTALLED AT HIGHER FLUID LEVELS WITH USE OF ANCHOR.

CONVENTIONAL TYPE, illustrated in running position with common working barrel assembly.

W.C. NORRIS MANUFACTURER, INC.

TULSA, OKLAHOMA

BRANCHES
HOUSTON, KILGORE, ODESSA, TEXAS. SALEM, ILLINOIS
West Coast Distributors:
REPUBLIC SUPPLY COMPANY OF CALIFORNIA, Los Angeles

DISTRICT OFFICE:
Republic Bank Building, Dallas
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BUY WAR BONDS FOR VICTORY

AIRCO GASES

. . . FOR PRODUCTION, MAINTENANCE AND RESEARCH

AIRCO gases, produced by modern scientific methods to the strictest standards of purity and uniformity, are supplied to industry through nation-wide Airco distributing points. These gases are available in volumes to meet every requirement . . . in standard commercial size cylinders and in trailers with capacities up to 40,000 cu. ft. Thus Airco gases are quickly delivered to shops and plants throughout the country in whatever size containers are most suitable for the customers' needs. In that way, individual requirements for 200, 20,000, or several million cubic feet, monthly, are met.

To assist manufacturers in using these Airco gases most effectively, Air Reduction provides "on-the-job" technical assistance through its Applied Engineering Field Service Department. For further information on Airco gases—as well as Airco's complete line of apparatus and supplies for every oxyacetylene flame application and arc welding need—call or write the nearest Airco office, or, if you prefer, communicate direct with the New York Office, Department PE.

OXYGEN guaranteed 99.5% pure . . . assures maximum speed and economy in cutting, and greater efficiency in welding.

ACETYLENE proved by use and test to be the most economical fuel gas for oxyacetylene welding and other flame applications.

NITROGEN dry and inert, contains less than 0.3% oxygen. Also available at higher purity to meet specialized needs.

HYDROGEN produced electrolytically, contains less than 0.5% oxygen.

ARGON manufactured pure or mixed with nitrogen as specified by user.

HELIUM is available with a purity of approximately 98% and higher.

★ BUY UNITED STATES WAR BONDS ★

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General Offices: 60 EAST 42nd STREET, NEW YORK 17, N. Y.

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The Petroleum Engineer, published monthly, August through June, semi-monthly in July, by The Petroleum Engineer Publishing Company, seventh floor Irwin-Keasler Building, Dallas, Texas. Subscription price, $2.00 per year, $3.00 for 2 years, 25¢ a copy. Entered as second-class mail matter May 1, 1932, at the post office at Dallas, Texas, under the Act of March 3, 1879.

WHEATLEY

HAS BEEN "On the Job" FOR AMERICA'S GREAT PIPE LINES

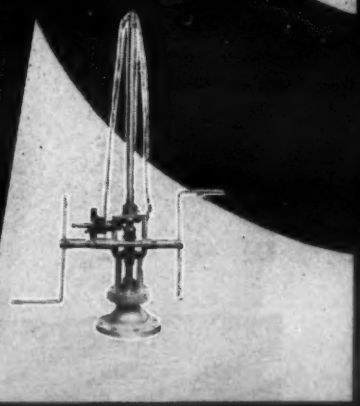
We never forgot the oil industry that was responsible for the development of our equipment and the growth of our company.

As illustrated here, we have furnished important equipment on two of the world's biggest pipe line projects. And critical equipment which we have furnished to the U. S. Navy is so vital we cannot discuss it here.

Yes, we've been doing our part to the maximum of our ability, and YET, we have met every need of the oil industry during the national emergency.

Our Army and Navy contracts were completed in separate locations in our plant; on special equipment and machines; did not interfere in any way with our service to civilian customers.

Wheatley products and deliveries alike were good before the war; they have been better during the war; NOW, they are better than ever.



W WHEATLEY

EVERY LENGTH OF WIRE ROPE NOW IN SERVICE IS VITAL TO WINNING THE WAR

Keep yours fit and working for the duration

Wire rope serves constantly on all fronts: in mines and quarries . . . oil-fields and timberlands . . . mills and shipyards . . . at the docks — hoisting, pulling, moving materials for production . . . loading, shipping, delivering fighting tools to our fighting men. And every length in service now must last longer than ever before.

Make your wire rope last . . . by extra care . . . by guarding its life . . . for wire rope is the lifeline to victory. Your regular source of supply is ready to give you helpful information on how to make your wire rope last longer . . . how to get maximum ton-miles of service from your rope in service.

HOW TO MAKE YOUR WIRE ROPE LAST LONGER

1. Select the right rope for the job *by getting proper construction; right size; right lay; full allowance for safety factor.*
2. Install wire rope properly *by unreeling it correctly; winding on drum properly; not allowing rope to kink; fixing clamps properly; reeving rope through sheaves and blocks carefully; seizing rope-ends thoroughly.*
3. Be diligent in maintenance of your wire rope *by inspecting it regularly and carefully; inspecting sheaves and bearings often and thoroughly; checking lubricant frequently; cleaning rope regularly; avoiding impact or shock loads.*

JONES & LAUGHLIN STEEL CORPORATION

WIRE ROPE DIVISION

PITTSBURGH, PENNSYLVANIA

Oil For Tomorrow

KNOWN reserves shrink rapidly as American oil goes all over the world to fight and win the war.

Where, then, is the oil for tomorrow... oil to power our peacetime cars and trucks and planes, to heat our homes and buildings, to supply raw materials for the miracle products of the Chemical Age?

The answer is--Oil is here, in America ... waiting to be found. No, perhaps adequate discoveries cannot be promised if drilling is to be dictated by politics and bureaucracy. But keep Private Enterprise free, to reward risk and effort, and America will have plenty of oil.

To help you find and produce the oil for tomorrow there will be plenty of Youngstown tubular goods---pipe you can always depend on for uniformity and top quality...because it is built by skilled, veteran craftsmen who have met your most exacting needs for 42 years.

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO
Manufacturers of
CARBON - ALLOY AND YOLOY STEELS
Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Electrolytic Tin Plate - Coke Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels.

Powell's Past ... your assurance of Future Performance

For every problem in flow control, there'll always be a POWELL Valve to lick it!

Powell Valves for controlling flow in your industry were not just "born"—they're a product of evolution—the result of nearly a century of patient study, research and experimentation by Powell's staff of Engineers and Metallurgists. Therefore you can be sure TODAY that TOMORROW—as in the past—there'll be Powell Valves to meet every existing requirement for dependable flow control. Shown here are some POWELL Valves especially adapted for use in water, steam and air lines. The complete Powell Line includes all types of valves (Globes, Angles, Gates, Checks, Ys, etc.) not only in bronze, iron and steel but also in a wide variety of pure metals and special alloys to meet every requirement of the Petroleum Refining Industry for corrosion resistance.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati 22, Ohio

Fig. 1793—Large size Iron Body Bronze Mounted Gate Valve for 125 Pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat rings and taper wedge solid disc. Also available with double disc–Fig. 1444.

Fig. 1460—Iron Body Bronze Mounted "Master Pilot" Gate Valve for 150 Pounds W. S. P. (¼" to 2") and 125 pounds W. S. P. (2½" to 4".) Has screwed ends, bolted flanged bonnet and taper wedge solid disc.

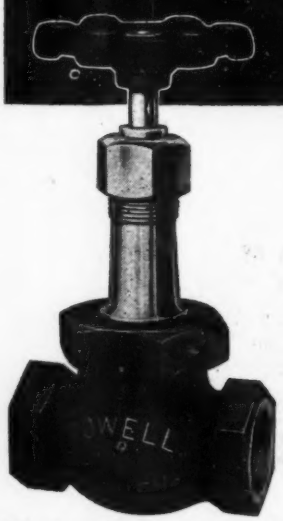


Fig. 190—Iron Body Bronze Mounted Globe Valve for 150 Pounds W. S. P. Has screwed ends, union bonnet, and regrindable, renewable nickel-bronze seat and plug type disc.

Write Dept. J, for our new booklet—"Powell Valves for Corrosion Resistance"

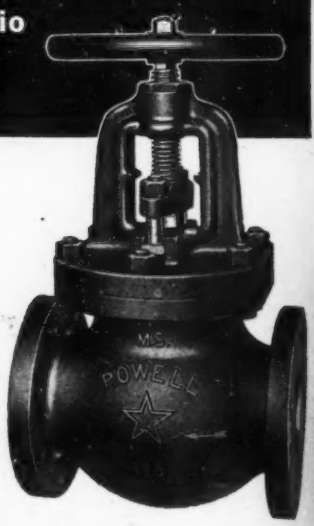
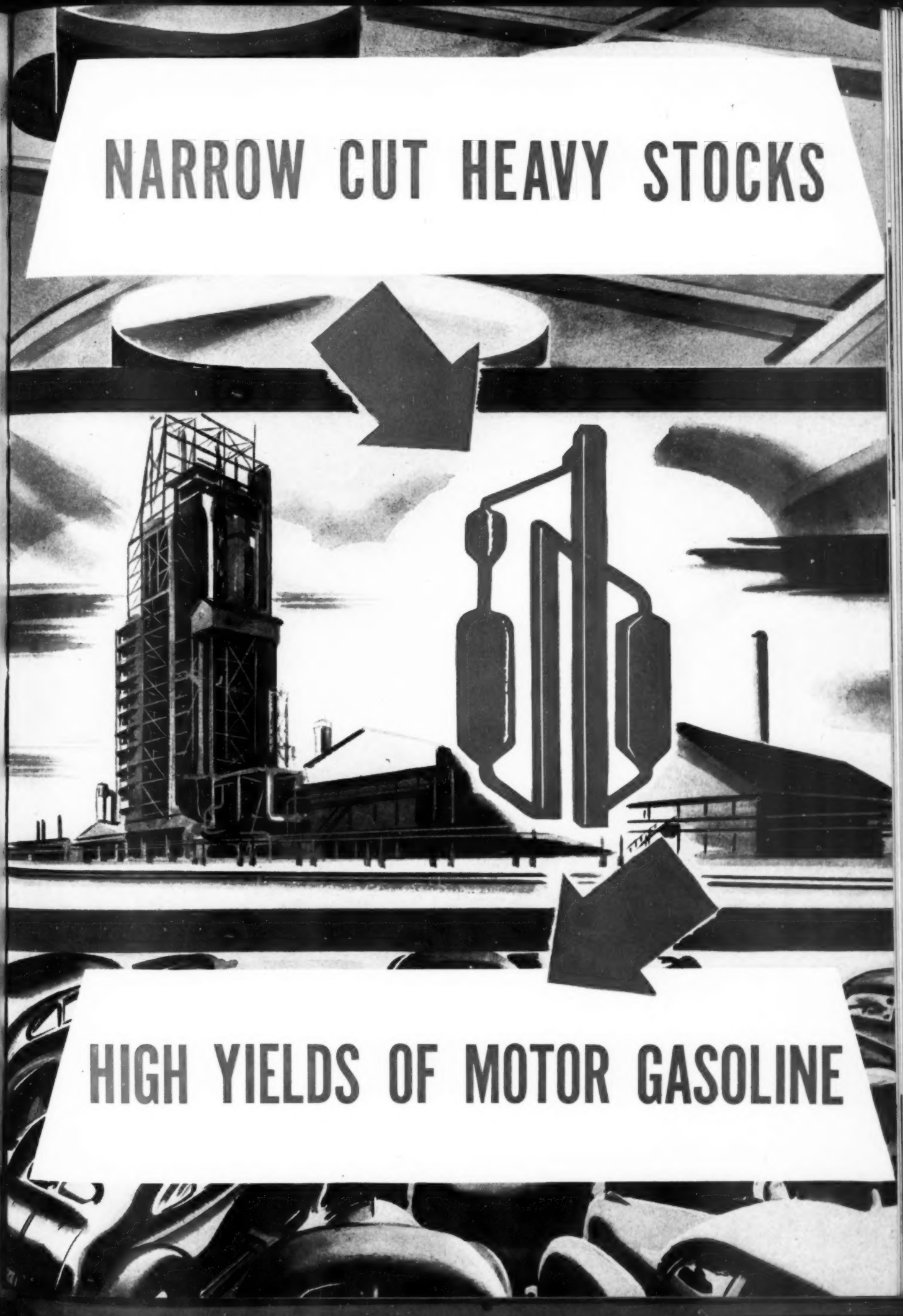
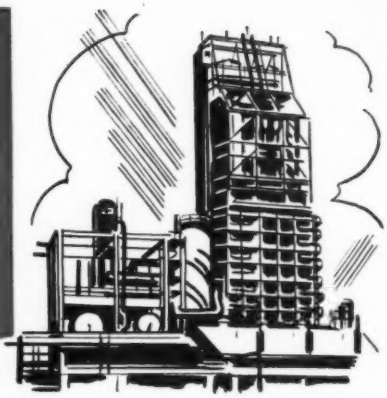


Fig. 241—Large size Iron Body Bronze Mounted Globe Valve for 125 Pounds W. S. P. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and spindle-guided disc.

POWELL VALVES


NARROW CUT HEAVY STOCKS
HIGH YIELDS OF MOTOR GASOLINE

TCC



THE PROCESS TO CONVERT NARROW BOILING RANGE HEAVY STOCKS TO HIGH YIELDS OF PREMIUM MOTOR GASOLINE

Narrow cut heavy gas oils, with mid-boiling points up to 775°F. — *undiluted with furnace oils or other valuable low-boiling materials* — processed once-through in Thermofor Catalytic Cracking* Units will yield:

- **— 48% to 53%, 10 lb. R.V.P. 400°F. end point high octane gasoline;**
- **— 20% to 30% high grade cycle stock suitable for use in No. 2 furnace oil.**
- **— propane-free liquid recoveries of 99% to 101% and 10 lb. motor gasoline plus cycle stock production of 86% to 92%.**

When desirable, coke still distillates and visbreaker distillates can also be effectively processed in T.C.C. units to high yields of high octane gasoline.

Thermofor Catafytic Cracking with T.C.C. Synthetic Bead Catalyst opens the way to higher quality premium motor gasoline at lower cost, particularly from narrow cut heavy gas oil stocks.

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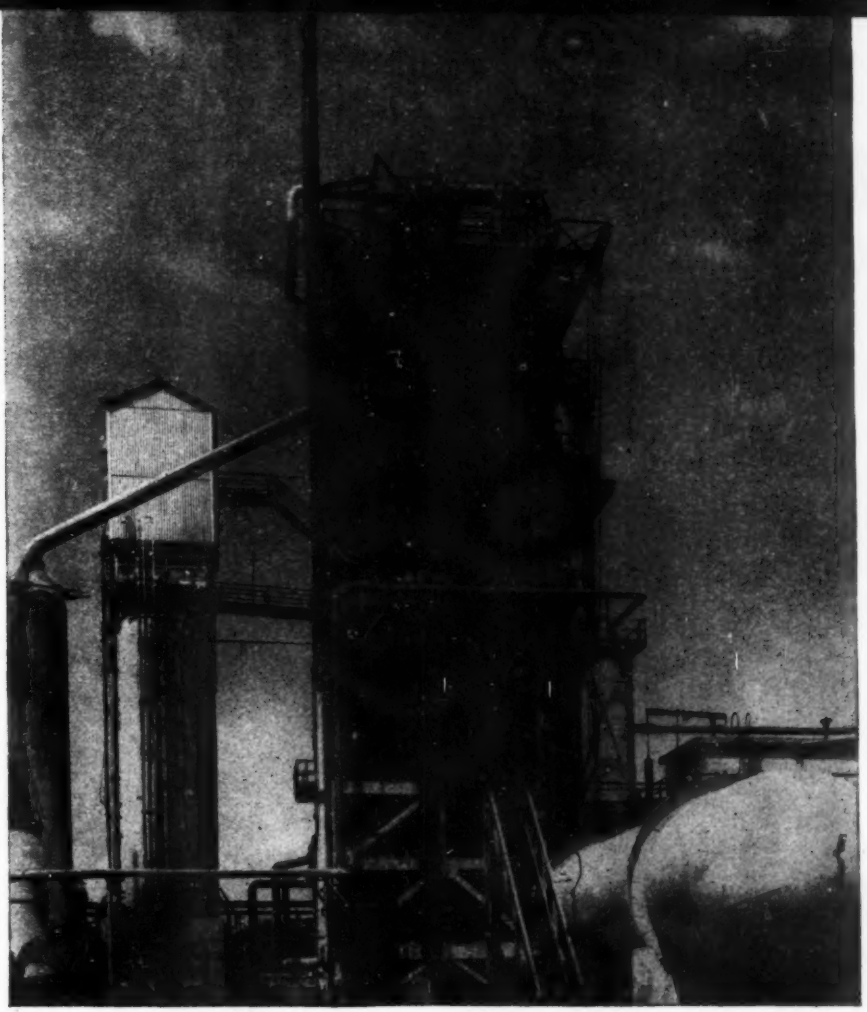
Mellie Esperson Building, Houston 2, Texas • 70 Barn Hill, Wembley Park, Middlesex England

***Licensed by Houdry Process Corporation**

LUMMUS

PETROLEUM REFINING PLANTS



?

What about catalytic cracking for the small refiner?

It's here now

The fluid catalytic cracking unit shown above has a charge capacity of 2600 barrels per stream day It was developed, designed and licensed by Universal and is in successful operation in the new plant of Frontier Refining Co., Cheyenne, Wyoming

Universal has designed other fluid flow catalytic cracking units ranging in capacity from 1500 to 16000 barrels per day—several are now in operation

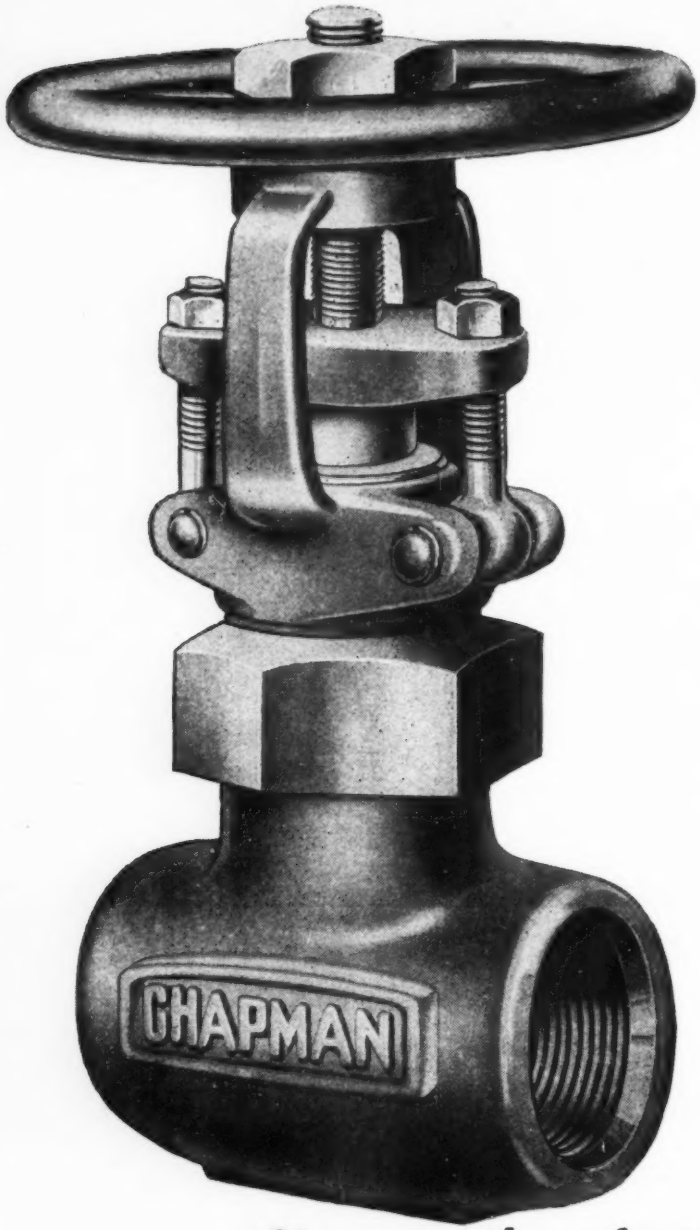
Universal Oil Products Co.
Chicago 4, Ill., U. S. A.

UOP

Petroleum Process Pioneers
For All Refiners

The Refiners Institute of Petroleum Technology

GASOLINE POWERS THE ATTACK — DON'T WASTE A DROP



CHAPMAN'S

NEW!

LIST 960 GATE VALVE

Gives you these features . . .

Replacing Chapman standard List 960 small forged steel gate valve of the rising outside screw type, the new List 960 is designed for still greater strength and longer service. Specifically, here are a few outstanding features:

★ Bonnet now fitted with a substantial forged steel yoke. A flanged forged steel packing gland is provided, thereby eliminating exposed threading on valve yoke, thus giving immunity from rusting and corrosion when placed in exposed locations.

★ Stems, plugs, and seat rings *on all valves* are heat treated stainless steel to insure greater working qualities.

★ Swivel bolts are used for holding the packing gland.

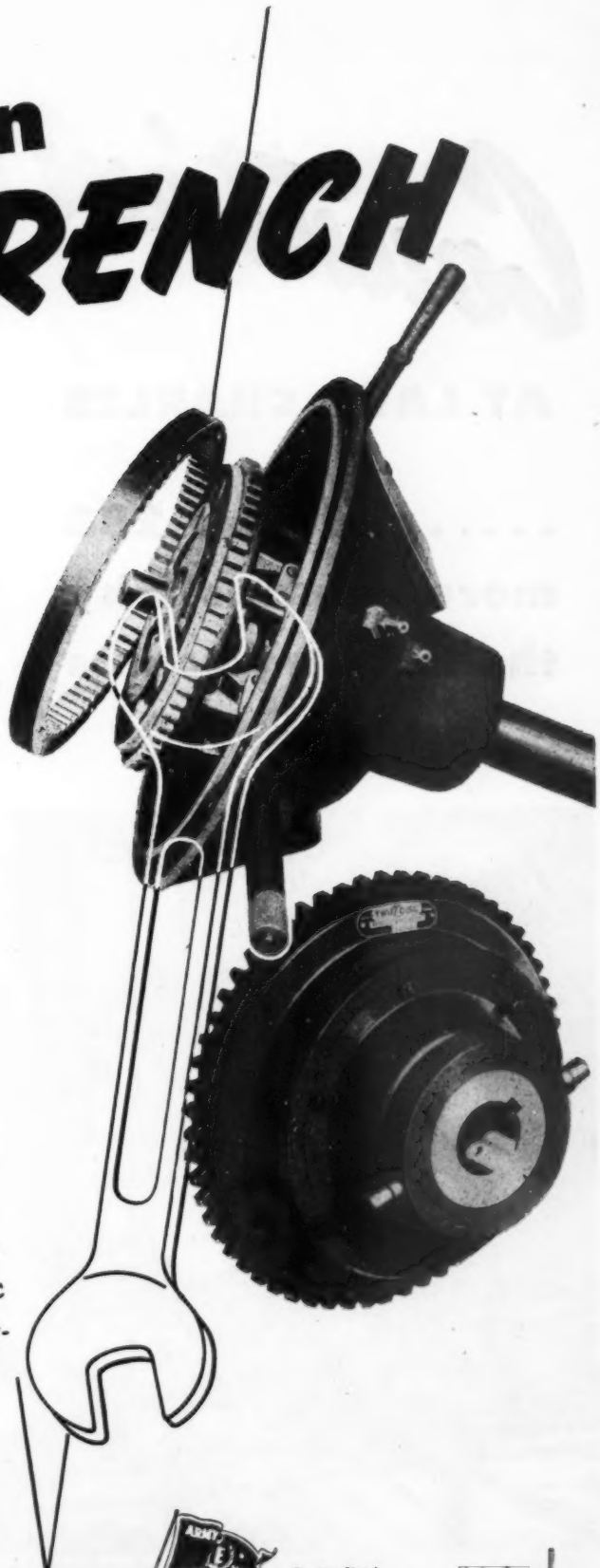
★ No gaskets to blow, as in valves with flanged bonnet connections.

Specify List 960 outside screw type in carbon steel for working pressures to 800 lbs. at 750° F. Or in alloy steel for service at 1000 lbs. working pressure at 750° F. Both valves available in screw and welding ends. Where service conditions make it preferable the List 960 rising stem inside screw type is available.

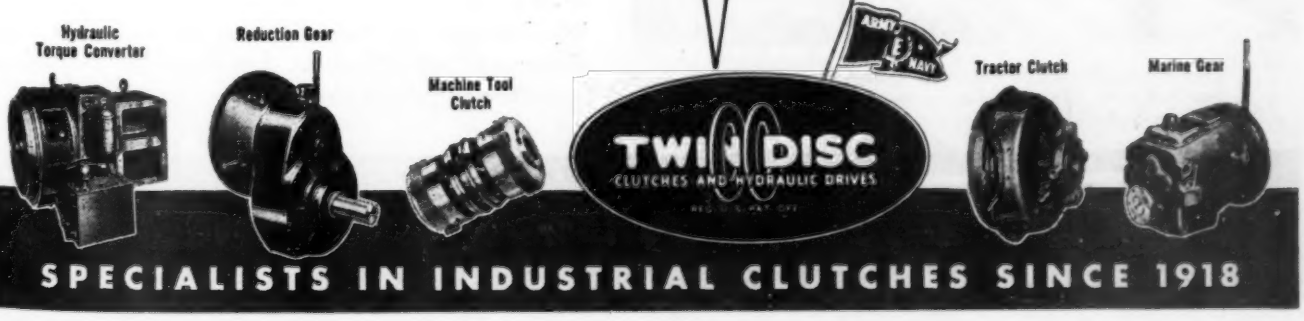
For greater pressures—get Chapman *List 990* with heavier walls and extra strength. In sizes up to and including 1½", with screw or welding end.

The Chapman Valve Mfg. Co., Indian Orchard, Mass.

As Common AS A WRENCH



By continuously standardizing on Twin Disc Clutches and Power Take-offs, the builders of oilfield machinery have eliminated the need for extensive explanations. Contractors, tool pushers and operators have become so well acquainted with the Twin Disc name plate, that it is "as common as a wrench." They recognize that a Twin Disc Clutch means trouble-free performance . . . simple, one-point, hand adjustment . . . the easy replacement of worn out parts when needed. Further they know that repair parts are quickly available from 7 factory branches and 30 parts stations covering every active field. This all adds up to more drilled feet with fewer interruptions, less time off the job when Twin Disc Clutches are used. Twin Disc engineers will welcome any new clutch problem; their 26-year experience in designing clutches for industry is your assurance of dependable recommendations. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

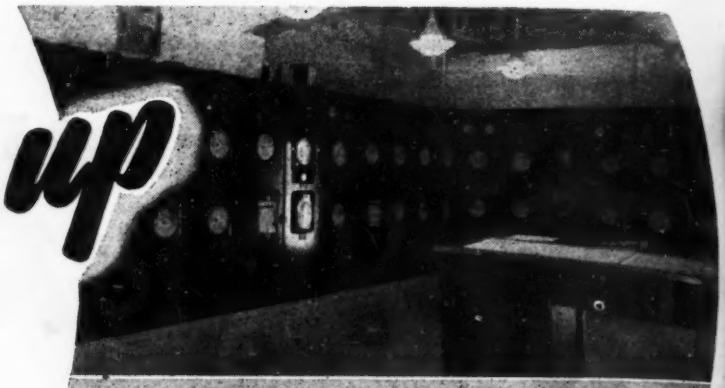


SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

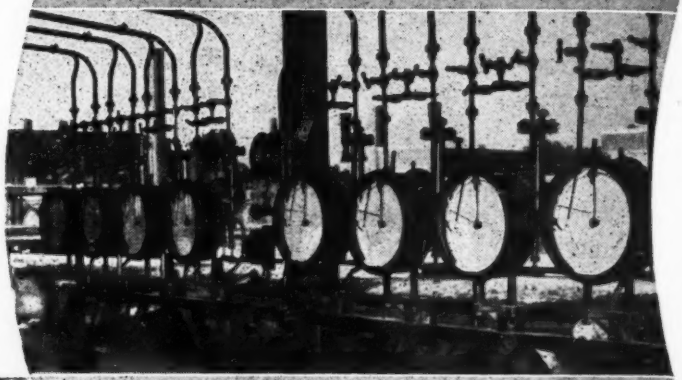
Count 'em up

AT LAKE CHARLES

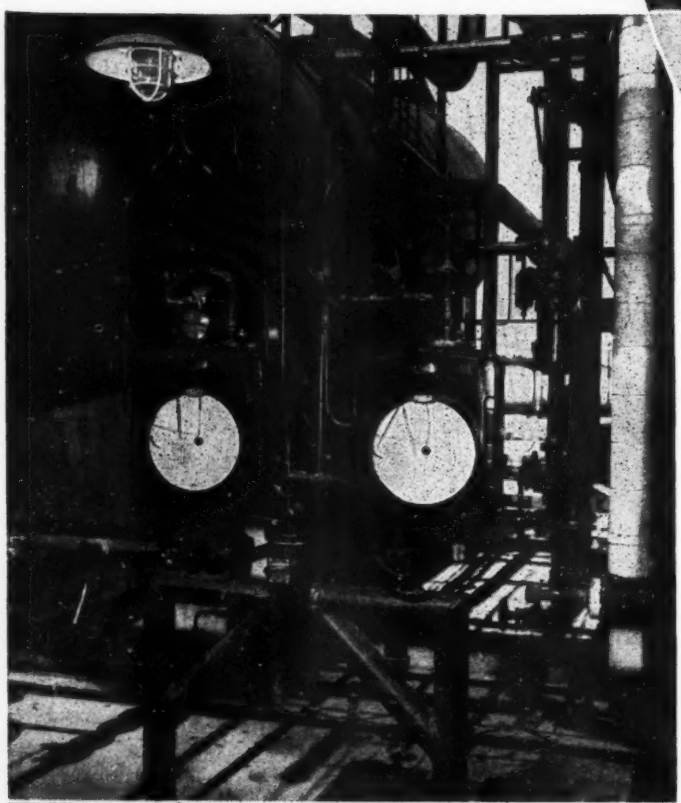
.....and find 283 more reasons why the industry counts on Foxboro!



Panel board for one of the 3 cracking units, showing some of the 283 Foxboro Recording, Controlling and Indicating Instruments.



Aviation fuel and butadiene processes in this plant depend on Foxboro Flow Meters, as well as Foxboro Temperature and Pressure Instruments.



Two of the Model 30 Stabilog Controllers that form the basis for the super-accurate integrated control systems at Lake Charles.

It's not surprising that the Cities Service Lake Charles Refinery is called "the world's most modern petroleum plant." It's the first new wholly-integrated aviation and butadiene plant ever built. Every step of its complex dual processing is controlled by the most advanced instrumentation. And right through the plant, these control systems are dominantly Foxboro!

Choice of more than 200 Foxboro Control Instruments for these critical operations was entirely logical. Throughout the wartime gasoline and butadiene industry, Foxboro Control based on the famous HYPER-RESET Stabilog Controller has set standards for operating stability and accuracy never equalled before. As a result, these vital plants have been equipped with more than 6,000 Stabilog Controllers alone!

Full discussion of the unique HYPER-RESET Stabilog Controller is available on request. **The Foxboro Company, 130 Neponset Avenue, Foxboro, Mass.** Branches in principal cities.

FOXBORO REG. U. S. PAT. OFF. **PROCESS CONTROL**

NEW AND BETTER PRODUCTS

EXPERIENCED FIELD SERVICE

FINEST LABORATORY FACILITIES

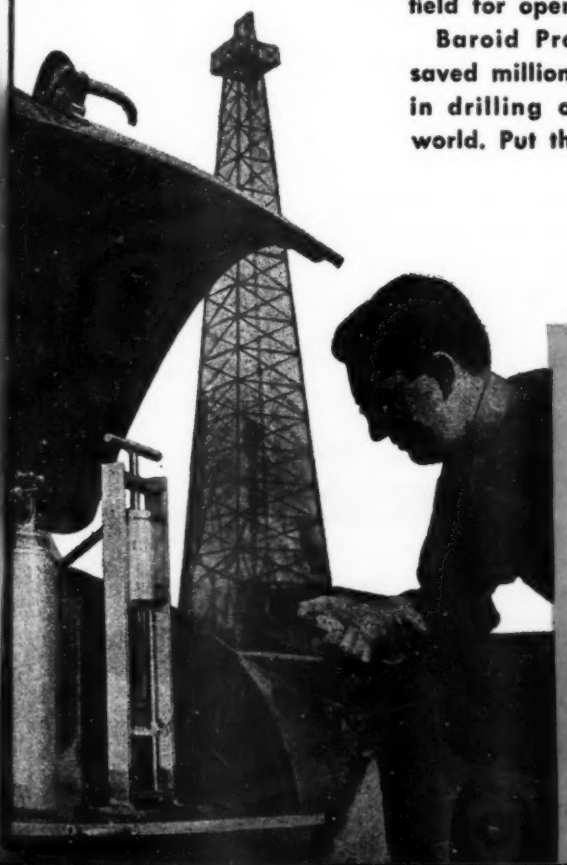
BAROID'S CONTRIBUTIONS TO FASTER, SAFER, MORE ECONOMICAL DRILLING

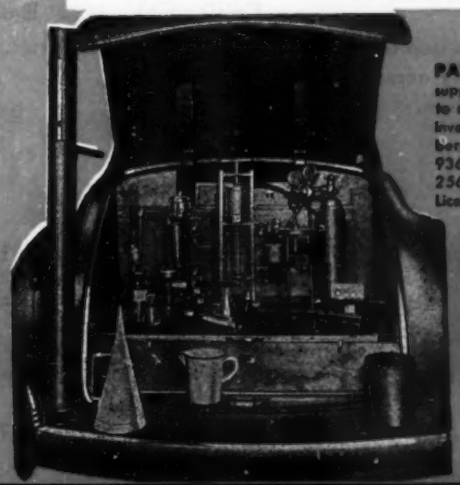
Baroid Products, Field Service and Laboratories have decreased the time, danger, cost and trouble of drilling wells. Many of these wells were in areas formerly considered extremely difficult to drill or which proved impossible to complete.

The quality of Baroid Sales Division's well-established products is constantly maintained or improved, and as new drilling problems arise, new products are developed for their solution. Baroid Service Engineers with laboratory-equipped cars and in collaboration with oil company mud engineers, help to use these products properly in the well for best results. Baroid Laboratories at Los Angeles, Tulsa and Houston reproduce actual well conditions so that drilling mud troubles may be anticipated and solved in advance to save time, trouble and expense in the field for operators.

Baroid Products and Service have saved millions of dollars for operators in drilling oil wells throughout the world. Put them to work for you!

Baroid Sales Division laboratories are provided with the latest and finest equipment for the furtherance of drilling mud technology.





BAROID SALES DIVISION

NATIONAL LEAD COMPANY

BAROID SALES OFFICES: LOS ANGELES 12 • TULSA 3 • HOUSTON 2

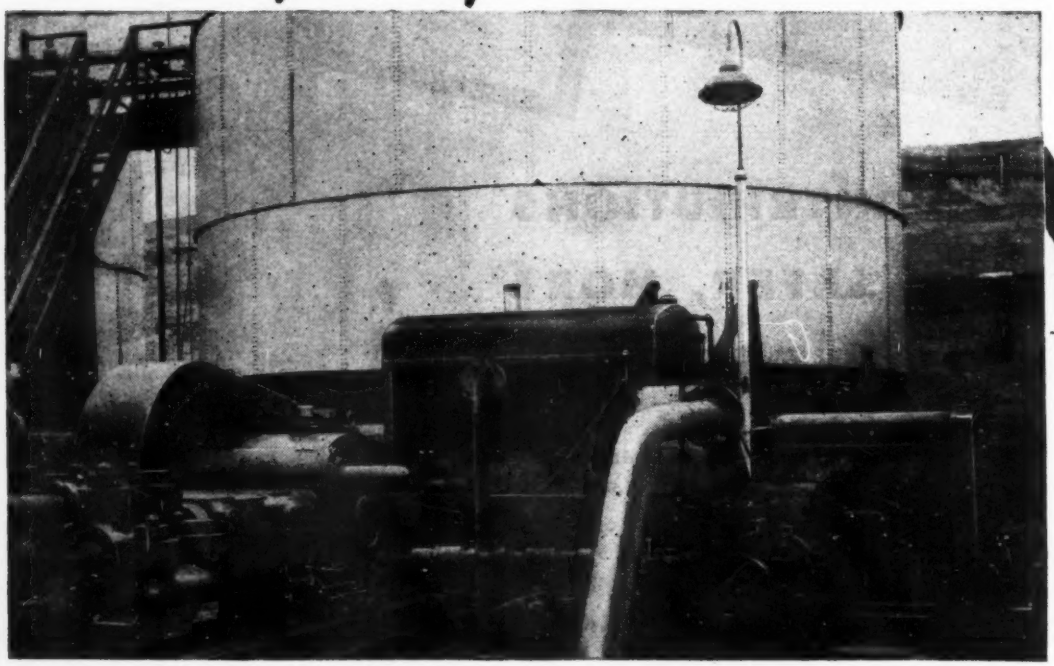
PATENT LICENSES, unrestricted as to sources of supply of materials, but on royalty bases, will be granted to responsible oil companies and operators to practice inventions of any and/or all of United States Patents Numbers 1,807,082; 1,991,637; 2,041,086; 2,044,758; 2,064,936; 2,094,316; 2,119,829; 2,214,366; 2,294,877; 2,304,256 and further improvements thereof. Applications for Licenses should be made to Los Angeles office.

BAROID PRODUCTS: ANHYDROX, AQUAGEL, AQUAGEL CEMENT, BAROCO, BAROID, FIBROTEX, IMPERMEX, MICATEX, SMENTOX, STABILITE, ZEOGEL, TESTING EQUIPMENT, BAROID WELL LOGGING SERVICE.

Baroid Service Engineers' cars are equipped completely to make mud tests right at the well.

POWER TO SPARE

to pump it there



Gardner-Denver "FX" Power Pumps

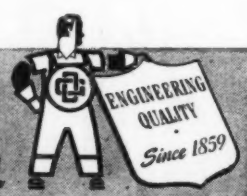
Moving oil from well to user calls for pumps that can keep a steady flow coming . . . that can keep pumping without pause. Gardner-Denver "FX" Power Pumps fit that need . . . with power to spare. For these pumps are designed with features that assure long, dependable service—features such as:

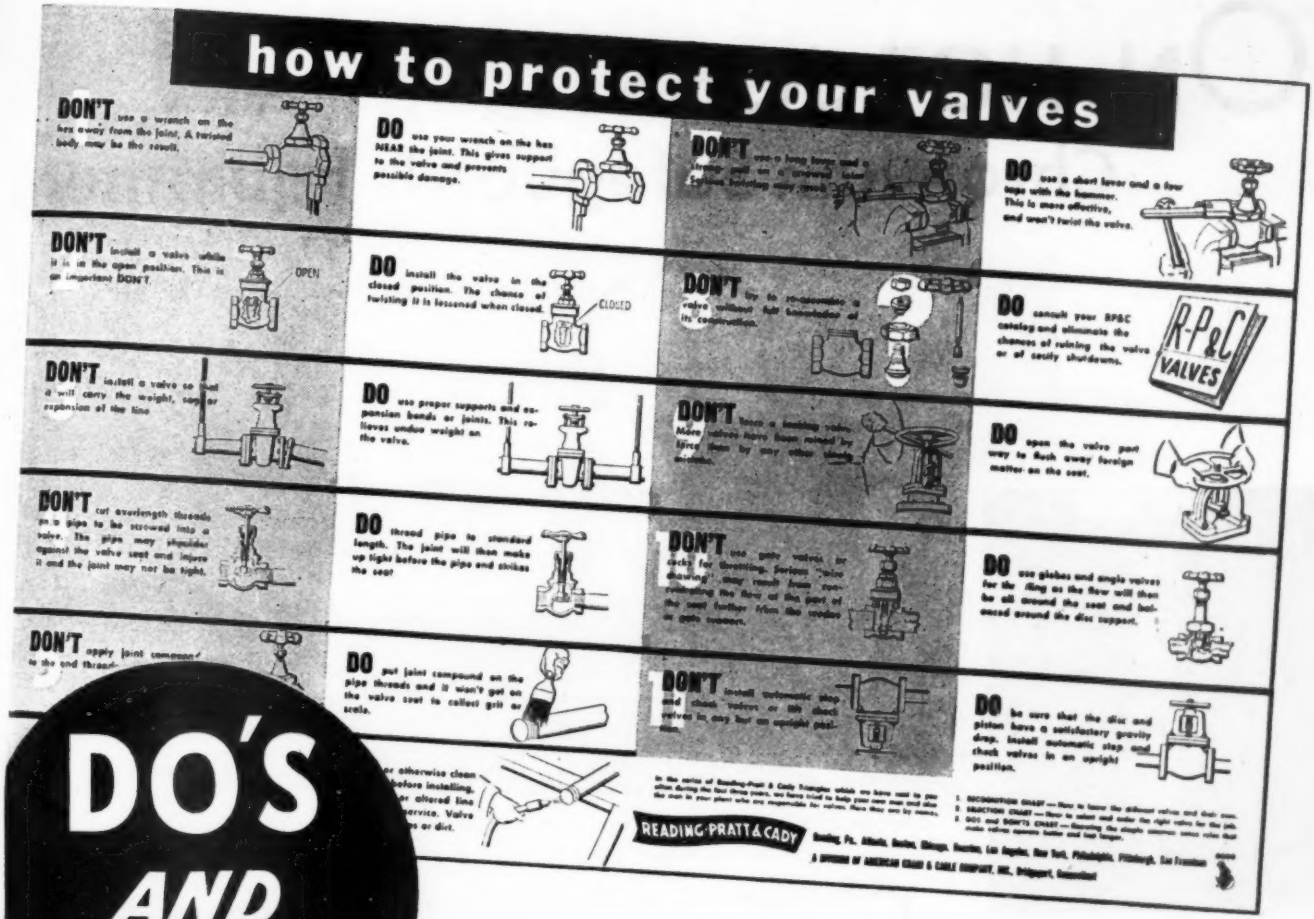
- **High strength and ruggedness due to divided fluid end construction of GarDurloy—the special alloy iron developed by Gardner-Denver—tested to 3,000 pounds hydrostatic pressure.**
- **Durable lightweight valves—top and bottom guided type, that are individually accessible without disturbing any other valves.**
- **Special pistons made especially for pumping crude or gasoline.**
- **Frame cast in one piece, with reinforced ribs for exceptional resistance to shock loads.**

•

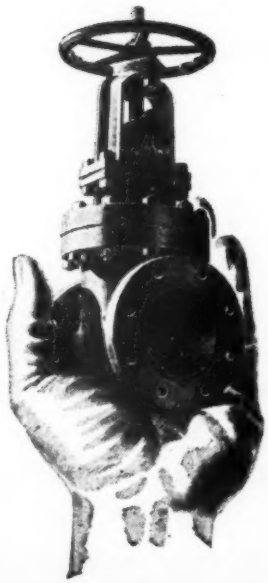
For complete information on "FX" Power Pumps for oil line service, write Gardner-Denver Company, Quincy, Illinois; Dallas, Houston, Tulsa, St. Louis, Los Angeles, San Francisco, New York, Chicago, Pittsburgh • Republic Supply Company (of California), 2122 East 7th Street, Los Angeles, California.

GARDNER-DENVER




how to protect your valves
DON'T use a wrench on the hex away from the joint. A twisted body may be the result.
DO use your wrench on the hex NEAR the joint. This gives support to the valve and prevents possible damage.
DON'T use a long lever and a sledge and on a screwed valve. Extreme twisting may result.
DO use a short lever and a few taps with the hammer. This is more effective, and won't twist the valve.
DON'T install a valve while it is in the open position. This is an important DON'T.
OPEN
DO install the valve in the closed position. The chance of twisting it is lessened when closed.
CLOSED
DON'T try to re-assemble a valve without full knowledge of its construction.
DO consult your RPSC catalog and eliminate the chances of ruining the valve or of costly shutdowns.
R-P&C VALVES
DON'T install a valve so that it will carry the weight, caused by expansion of the line
DO use proper supports and expansion bends or joints. This relieves undue weight on the valve.
DON'T leave a loading valve. More valves have been ruined by force than by any other single condition.
DO open the valve part way to flush away foreign matter on the seat.
DON'T cut overlength threads on a pipe to be screwed into a valve. The pipe may shoulder against the valve seat and injure it and the joint may not be tight.
DO thread pipe to standard length. The joint will then make up tight before the pipe end strikes the seat
DON'T use gate valves or cocks for throttling. Serious "wire drawing" may result from restricting the flow at this part of the seat further from the center of gate valves.
DO use globes and angle valves for the ring as the flow will then be all around the seat and balanced around the disc support.
DON'T apply joint compound to the end threads.
DO put joint compound on the pipe threads and it won't get on the valve seat to collect grit or scale.
DON'T install automatic stop and check valves or lift check valves in any but an upright position.
DO be sure that the disc and piston have a satisfactory gravity drop. Install automatic stop and check valves in an upright position.
DO'S AND DON'TS
READING-PRATT & CADY

. . . TO MAKE YOUR VALVES SERVE YOU *BETTER-LONGER*



This is the third of the series of charts developed by Reading-Pratt & Cady as a service to the valve users of the nation. Like the other two—How To Know Valves and How To Select Valves—this one, How To Protect Your Valves, will serve as a reminder to experienced men and as invaluable information to new men in industry. It tells in pictures and simple, non-technical language how to avoid the mistakes that shorten the life of valves—how to get maximum service from them.

For copies of this chart, address our offices in Reading, Pennsylvania. There's no charge, of course.

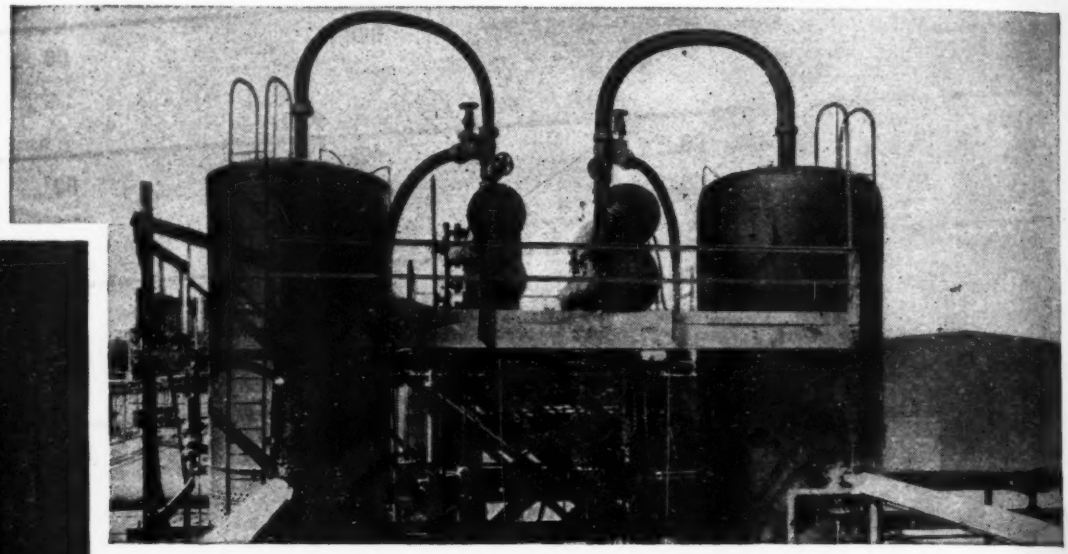
READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

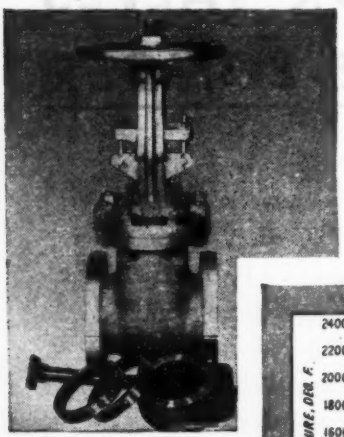
A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT

ON HOT JOBS . . .
Chromium Safeguards Equipment

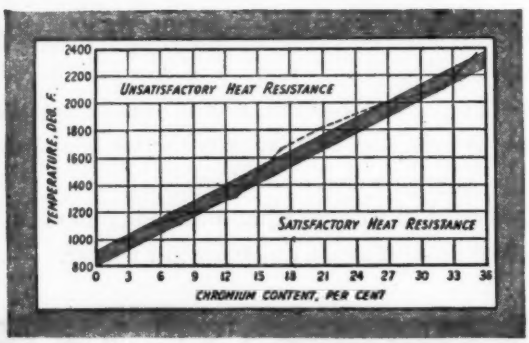


The use of 18-8 chromium-nickel stainless steel permits the use of higher temperatures in cracking stills.

Cast 29-9 chromium-nickel steel was selected for this fractionating tower because this alloy resists corrosion at elevated temperatures.



Working parts of this 150-lb. gate valve are made of 11.5 to 13 per cent straight chromium iron to resist high temperature.



CHROMIUM irons and steels can stave off the oxidation and corrosion that ruins refinery equipment where high temperatures are encountered.

Stainless steel bubble caps withstand corrosion of elevated temperatures. Even the high pressure and extreme heat to which furnace tubes are subjected will not alter the chromium steel of which they are made. Gaskets, orifices, plates, supports, and spacers too—when made of chromium irons or steels—give increased service life under tough conditions.

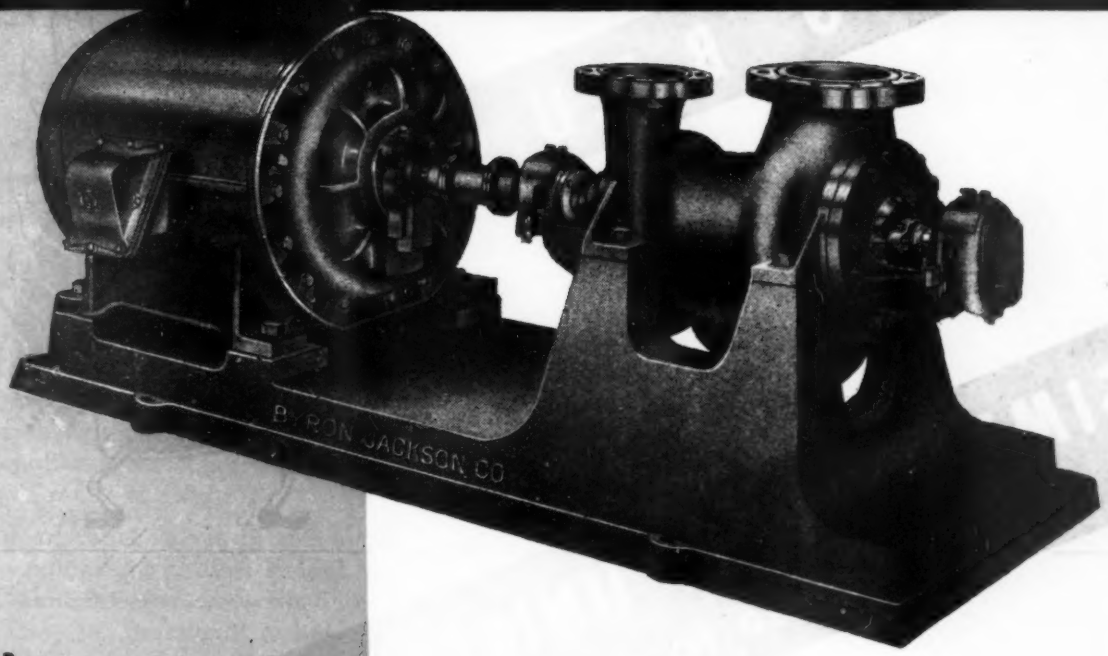
Although we do not make iron or steel of any kind, we have produced ferro-alloys for 38 years, and have accumulated a vast fund of data on the irons and alloy steels in which they are used. The benefit of our experience is available to help fabricators and users of equipment that is subject to extreme conditions. Write to us for further information.

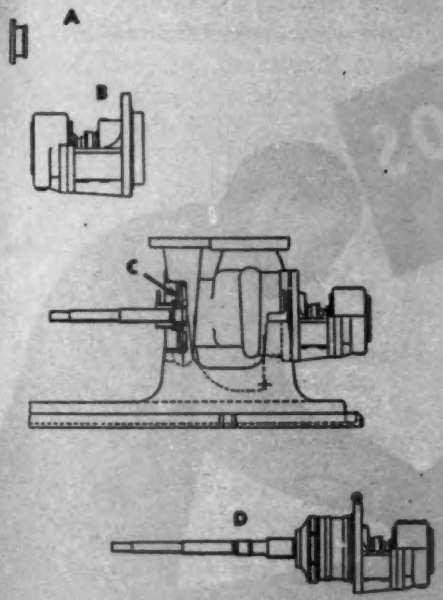
BUY UNITED STATES WAR BONDS AND STAMPS

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

Electromet
Trade Mark
Ferro-Alloys & Metals

ENTRANCE VELOCITIES *Lower*
NET POSITIVE SUCTION HEAD *Lower*





In dismantling, when the pump half of the flexible coupling (A) has been removed, the sleeve bearing housing and discharge cover (B) are withdrawn as a unit, giving access to the second stage impeller (C) which is removed with a standard impeller puller. Bolts holding the suction cover to case are then removed and the remaining portion of the rotating element (D), including the ball thrust bearing with its housing, the suction cover and the first stage impeller, are removed as a unit. Suction and discharge piping are not disturbed when dismantling the pump.

with
Byron Jackson Hot Oil Pumps

For capacities ranging from 1,400 to 2,000 gpm. with heads from 700 to 1,100 feet at 3,550 rpm, and temperatures to 900° F., Byron Jackson engineers have developed a 6" x 8" x 12½" Double Suction Hot Oil Pump. Contained within a heavy duty, vertically split case with confined gaskets, is a two stage unit, the first stage of which is double suction while the second stage is single suction. Employing this type of construction, initial entrance velocities have been materially lowered permitting operation of the pump at substantially lower npsh.

Staggered volutes provide radial balance, while hub wearing rings on the second stage give axial balance. By bleeding leakage from the second stage hub wearing rings to suction, both stuffing boxes are subjected to suction pressure only. Stuffing boxes are extra deep and both stuffing boxes and bearings are water-jacketed. Stuffing boxes are provided with "in and out" seal oil connections. Bearings are ring oiled.

Byron Jackson engineers have had long experience in pumping liquids of varied viscosity and volatility. This is your assurance that we can be of service in working out your particular pumping problems. The opportunity will be welcomed.

BYRON JACKSON CO.

Houston • Los Angeles • New York

LOSING B.T.U.s?

SIMPLY APPLY UNIBESTOS
it's simple to apply!

Consider these important heat-saving factors in UNIBESTOS construction and method of application: It is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5" . . . affords a neat, tight job without efficiency-impairing gaps. Standard UNIBESTOS is available for service up to 750°; combinations of Standard and Super UNIBESTOS in single layer construction are available for service up to 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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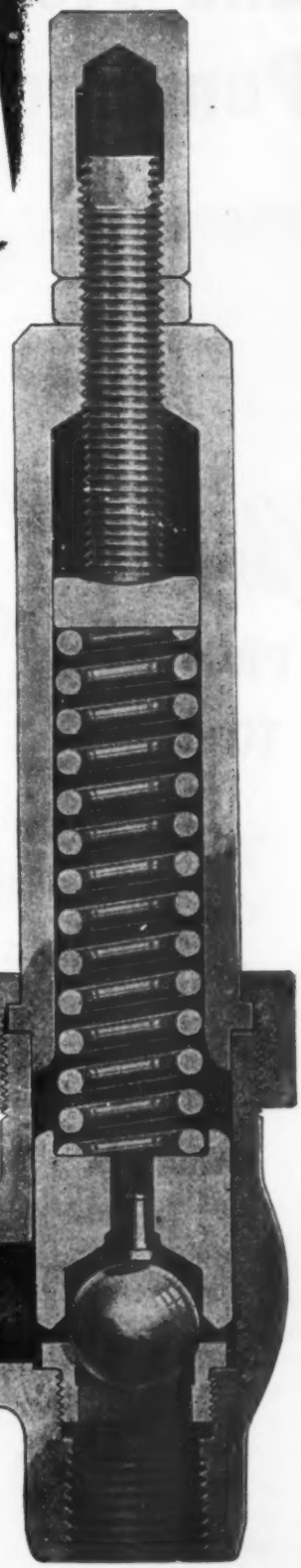
UNION ASBESTOS & RUBBER CO.

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

NUMBER FOUR OF A SERIES ON VALVE SELECTION

Protect equipment against abnormal pressure increases *with* Edward RELIEF VALVES



WHETHER for power, marine, chemical process, petroleum, refining, hydraulic or general industrial services, the most important consideration in selecting relief valves is *absolute dependability.*

Edward relief valves protect expensive equipment against sudden and unusual pressure increases in all kinds of services. Functional design, with only a few parts all built to extraordinarily high precision standards, and production-run quantities make Edward relief valves surprisingly low in initial cost and exceptionally economical over the long pull.

Since every valve is factory set for the required relieving pressure, inquiries should include information concerning service, frequency of operation, and relieving pressure.

Regularly available in ¼ in. to 2 in. sizes inclusive.

Look for These IMPORTANT POINTS

BODY
Drop forged heat treated steel. Distribution of metal around body flow areas equalized so that in heating and cooling there is negligible distortion.

BONNET
Rolled carbon steel, with body and locknut joints carefully ground for tight fit.

BEARING PLUG
Hardened stainless steel. Point contact always permits disk to reseat promptly and tightly.

BALL DISK
Hardened corrosion resistant stainless steel, accurately ground for tight seating.

SPRING
Fine carbon or stainless steel spring, adequate length for full area when discharging. Design of adjusting mechanism makes possible close pressure regulation.

SEAT
Renewable EValloy stainless steel, with sturdy shoulder and full threads engaging body.

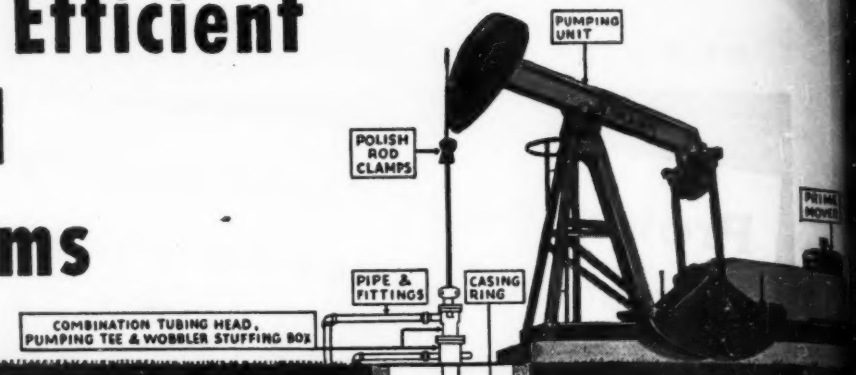
FIG. 141

Is Edward BETTER VALVES *Catalog 102 in your files? If not, write for your copy today.*

THE EDWARD VALVE & MFG. CO., INC. • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

Everything for Efficient and Economical Pumping Systems



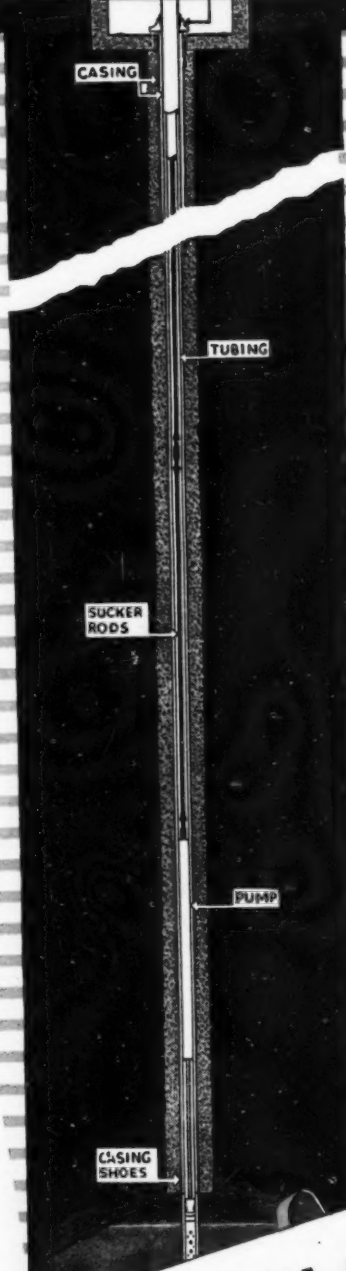
Complete installations

PROPERLY PROPORTIONED TO FIT YOUR CONDITIONS

When properly engineered for the job, modern rod-type pumping systems are the most economical both in first cost and in lifting cost. Nothing can equal them for overall efficiency.

Bethlehem not only furnishes every item from the engine to the bottom-hole pump, but maintains a large staff of engineers to help with your selection problems.

BETHLEHEM STEEL



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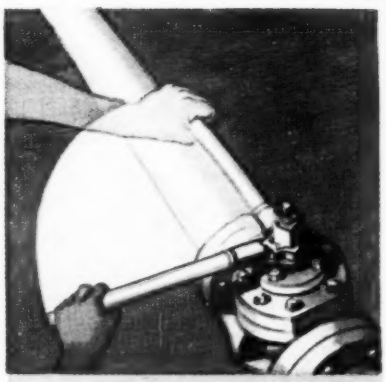
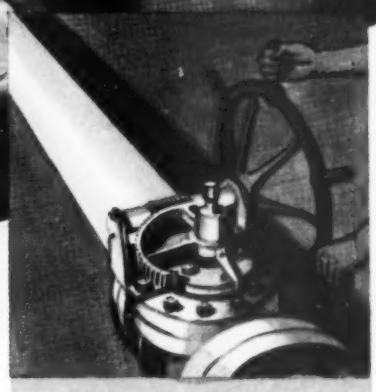
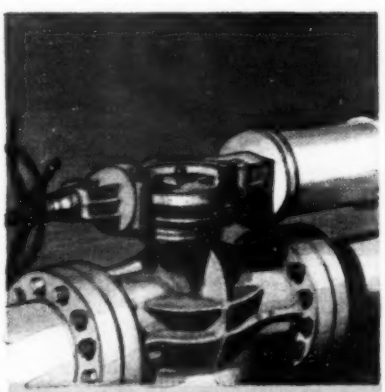
Does TIME *mean anything to you in valve operations?*



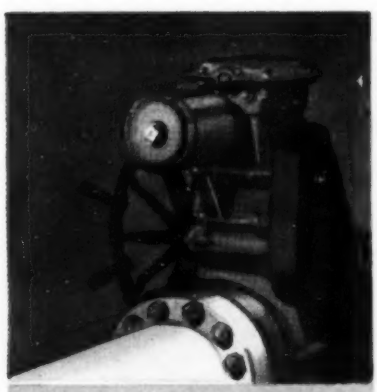
QUARTER TURN
FOR SIMPLICITY OF CONTROL



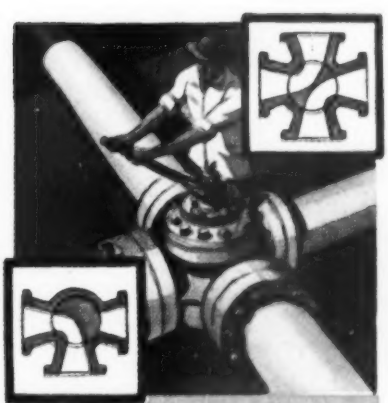
QUICK GEAR OPERATION
FOR HEAVY DUTY SERVICE



CYLINDER OPERATION
FOR AUTOMATIC CONTROL

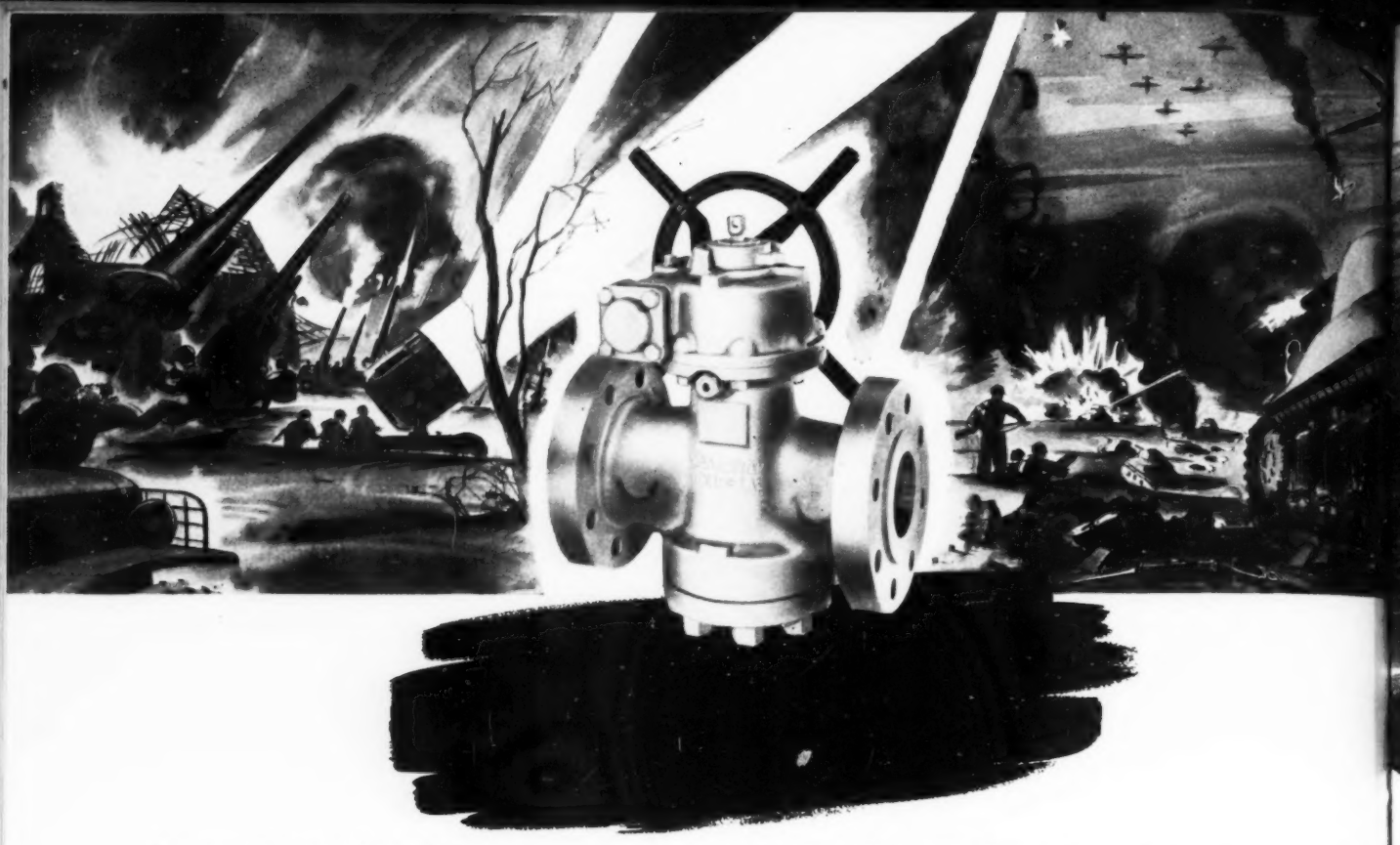


ELECTRIC MOTOR OPERATION
FOR REMOTE CONTROL



MULTIPORT DESIGN
FOR SELECTIVE SWITCHING

Nordstrom Valves



Some say: *"It's a mechanized War."*

Others state: *"It's a chemical War."*

Still others claim: *"It's an aerial War."*

Regardless of what it may be called, War relies upon industrial science to provide our fearless fighters with the implements of Victory.

100-OCTANE GASOLINE. America has rushed to completion scores of aviation fuel refineries, all of which are using Nordstrom Valves to insure uninterrupted flow and absolute control of lines.

SYNTHETIC RUBBER. The tire companies, the U. S. Government and scores of petroleum refineries have joined forces to offset the shortage of natural rubber. The highly technical processes of synthetic rubber production require lubricated plug valves—Nordstroms.

BLOCK BUSTER EXPLOSIVES. Our chemical plants and munitions makers have far outclassed the enemy by development of the most devastating explosives. In these plants where danger must be minimized and valves must offer the highest degree of dependability, Nordstroms are considered critical necessities.

LIGHT METALS. Aluminum and magnesium, now produced in quantities in excess of war's needs, are the result of advanced chemical technique. Nordstrom Valves are rendering vital service in all the modern plants producing these critical light metals.

Of no less importance in contributing to the War effort is the army of Nordstrom Valves serving the gas industry, the petroleum industry in all its branches, shipbuilding yards and hundreds of plants producing war materiél.

It has been a Herculean task to meet this overwhelming valve demand in the face of Government directives over which we have had no control. But by intensive effort we are increasing our output and speeding up deliveries.

Nordstrom

LUBRICATED VALVES

Sealdport Lubrication

MERCO NORDSTROM VALVE COMPANY — *A Subsidiary of Pittsburgh Equitable Meter Company*

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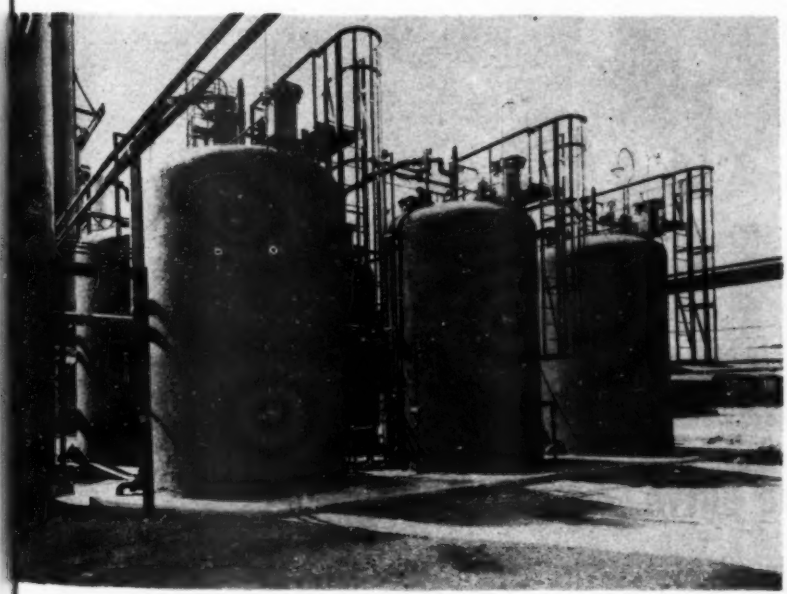
PRODUCTS: Nordstrom Lubricated Valves; Air, Curb and Meter Cocks • Nordco Valve Lubricants • EMCO Gas Meters • EMCO-McGaughy Integrators EMCO Regulators • Pittsburgh-National Meters for Gasoline, Grease, Oil, Water and other Liquids • Stupakoff Bottom Hole Gauges

... PROVED THE NECESSITY OF PETRECO DESALTING

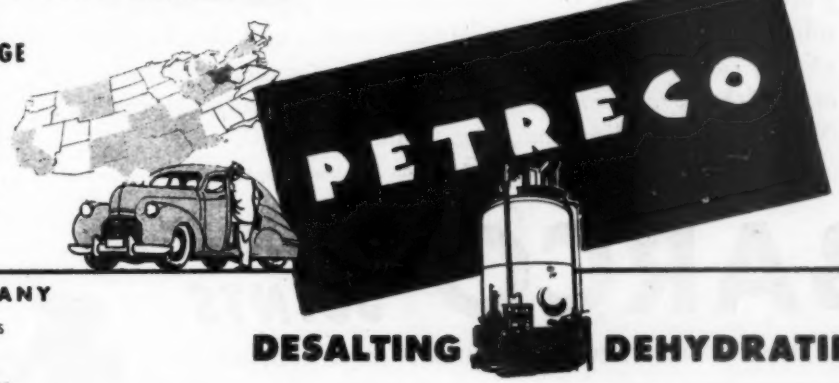


An Ohio refiner, charging Illinois crude, installed Petreco desalters on three refining units. To check the efficiency of the desalters, unit "A" was operated for 60 days charging Petreco processed crude. During this period there were two short shutdowns: one caused by a small fire, another to repair a leak. At the end of this 60-day run, the Petreco desalters were by-passed. Operations progressed normally for a week, then trouble began. Salt accumulated in the bubble plates of the crude fractionating tower, the streams went off color and slop oil resulted. Also, the overhead take-off lines and condenser coils became plugged with ammonia chloride.

The unit which had operated 60 days with the Petreco Desalting, had to be shut down for clean out *only 14 days after the Petreco desalters were by-passed!*

COMPLETE U. S. OIL STATE COVERAGE WITH PETRECO PROCESSES

Resident field engineers are located in refining and producing centers wherever Petreco processes are in use. These men are specialists, and are always available to assure maximum operating efficiency, and to give helpful advice and assistance on any problem of dehydration or desalting.



PETROLEUM RECTIFYING COMPANY

5121 So. Wayside Drive, Houston 1, Texas

648 Edison Building, Toledo 4, Ohio

530 West Sixth Street, Los Angeles 14, Calif.

Representatives in principal production and refining centers

ABSORBS VIBRATION...PROVIDES MOVEMENT

in the four corners of the earth

On every industrial and transportation frontier, Barco Flexible Joints stand guard over fluid-conveying pipes... helping to minimize the destructive action of vibration and shock. *Thirty years of continuous use have only strengthened engineering endorsement of the Barco principle and design.* Barco Manufacturing Co., Not Inc., 1825 Winnemac Ave., Chicago 40, Ill.

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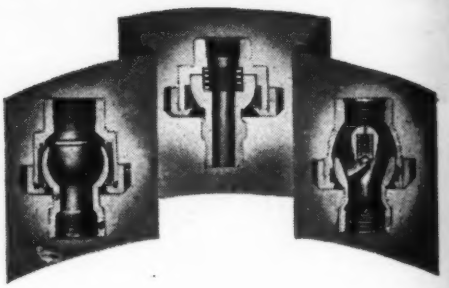
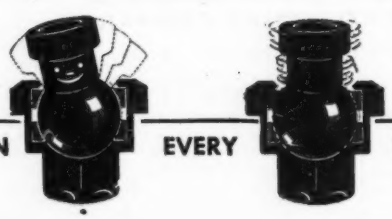


BARCO *FLEXIBLE JOINTS*

THE FREE ENTERPRISE SYSTEM IS THE SALVATION OF AMERICAN BUSINESS

Not just a swivel joint... but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.



"MOVE IN EVERY DIRECTION"

Not just a swivel joint... but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

GRANT

OIL WELL DRILLING & PRODUCTION TOOLS

For more than a quarter of a century, GRANT Tools have helped to drill wells faster and produce more oil with safety and economy. GRANT Tools are simple to operate and rugged for long life and meet the requirements of operators in both domestic and foreign fields.

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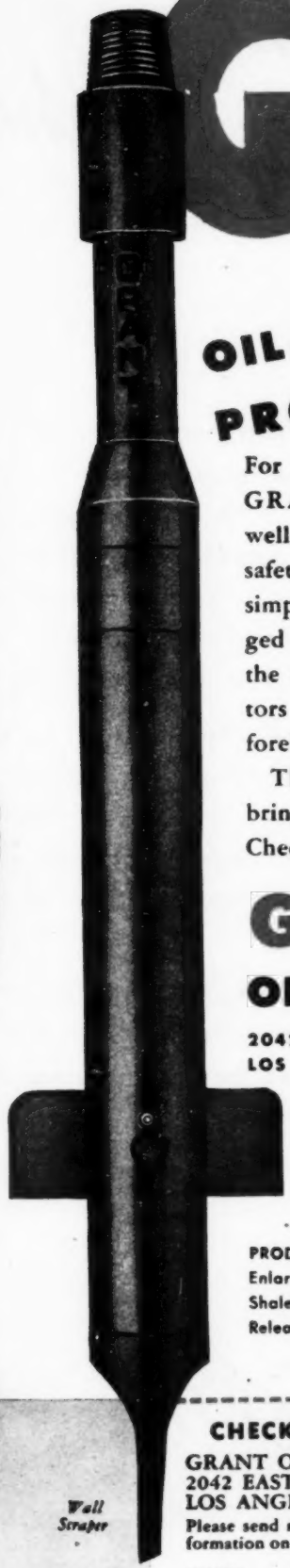
PRODUCTS: Bailers, Cleaners, Hole Enlargers, Liner Pullers, Reamers, Shale Bits, Safety Automatic Pressure Release (Mud Pumps), Underreamers, Wall Scrapers.

Underreamer



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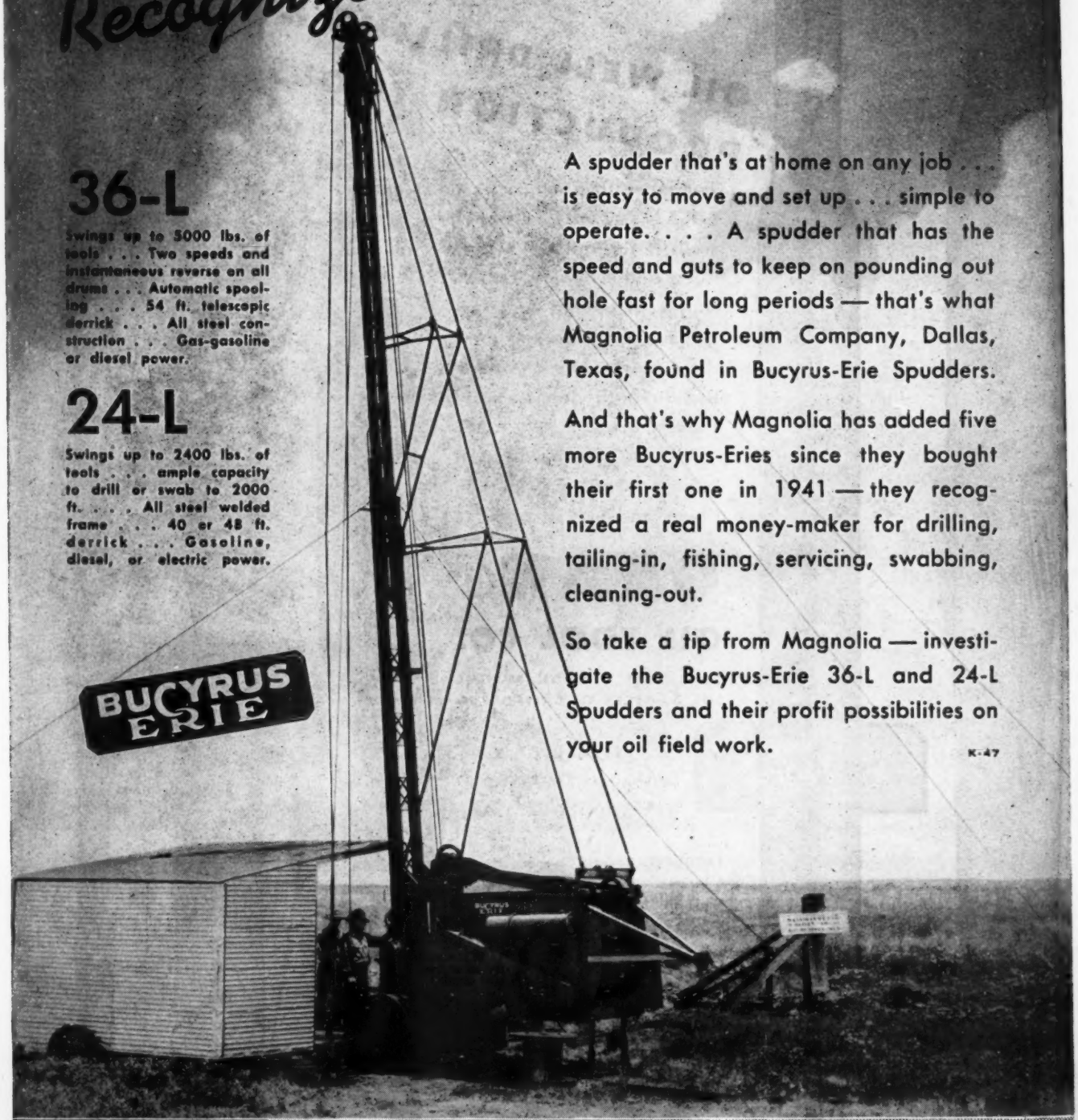
Magnolia Petroleum Co.

Recognizes a Money-Maker



36-L

Swings up to 5000 lbs. of tools . . . Two speeds and instantaneous reverse on all drums . . . Automatic spooling . . . 54 ft. telescopic derrick . . . All steel construction . . . Gas-gasoline or diesel power.

24-L

Swings up to 2400 lbs. of tools . . . ample capacity to drill or swab to 2000 ft. . . . All steel welded frame . . . 40 or 48 ft. derrick . . . Gasoline, diesel, or electric power.

BUCYRUS ERIE

A spudder that's at home on any job . . . is easy to move and set up . . . simple to operate. . . . A spudder that has the speed and guts to keep on pounding out hole fast for long periods — that's what Magnolia Petroleum Company, Dallas, Texas, found in Bucyrus-Erie Spudders.

And that's why Magnolia has added five more Bucyrus-Eries since they bought their first one in 1941 — they recognized a real money-maker for drilling, tailing-in, fishing, servicing, swabbing, cleaning-out.

So take a tip from Magnolia — investigate the Bucyrus-Erie 36-L and 24-L Spudders and their profit possibilities on your oil field work.

K-47

ARMY E ** NAVY

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

Have You Seen It?

THIS new postwar, general purpose Fairbanks-Morse Motor is available to industry now.

Never before have there been more stamina—more protection—more versatility—built into a motor housing.

You'll have to see it demonstrated to appreciate fully how much this motor can really offer you.

Write for detailed information. Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Look at These Features!

- ★ It is a 40°C. motor.
- ★ It is a protected motor.
- ★ It has an optional conduit box assembly.
- ★ It has cross-flow ventilation.
- ★ It has ball bearings—sealed-in and protected.
- ★ It has the exclusive Fairbanks-Morse COPPERSPUN ROTOR.

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
WATER SYSTEMS
SCALES
STOKERS
FARM EQUIPMENT
RAILROAD EQUIPMENT

Fighting or Producing, it Means the Same... *Be Ready!*

Whether it be a warship at sea alert for enemy craft, or a vital industrial plant geared to top production, delay at a critical time is costly, often disastrous. A good skipper knows the great importance of having his ship ready at all times for the command to "Stand By!" Likewise, management is aware of costly delay caused by forced shutdown due to regular gas supply failure.

A Pritchard designed Stand-By fuel system will eliminate such a possibility. Fuel can be delivered by rail tank car or truck at any time, and stored for an emergency or critical demand.

Possessing the same heating qualities as natural gas, Propane-air can be substituted in the industrial system without burner adjustments. In a matter of minutes complete or partial changeover can be made. BUTANE or PROPANE-BUTANE liquefied petroleum gas mixtures may be used interchangeably. NATURAL GASOLINE gas mixture may be used with minor adjustments to combustion equipment. J. F. Pritchard and Company design, engineer and construct complete *Stand-By* fuel plants to specifications, covering all types of fuel.

J. F. PRITCHARD & Co., *Natural Gas Division*, Fidelity Bldg., Kansas City, Mo.

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TULSA
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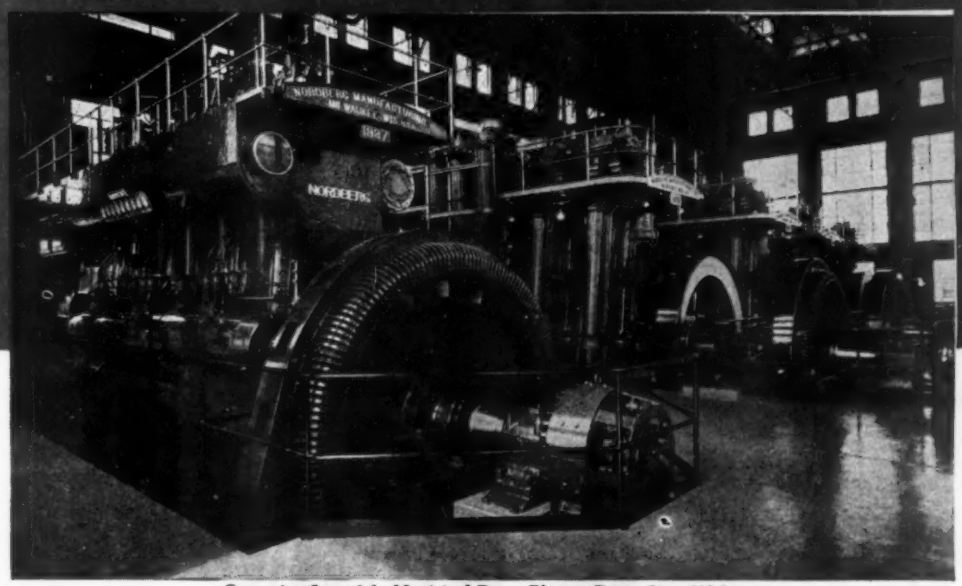
ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

Over 19,000 hours in operation

PORUS-KROME

still in good condition



Generating floor of the Municipal Power Plant at Ponca City, Oklahoma

Mr. Pat Schlesinger, Superintendent Municipal Water & Light Department, Ponca City, Oklahoma, has written us as follows:

"As you know, our plant burns a heavy-grade (8-10 gravity) fuel oil. Therefore our liner wear at times is somewhat excessive. On May 17, 1941, we installed a PORUS-KROME processed liner in our No. 5 engine. The results have been so satisfactory that we want to give you this report on it.

"Up to date the PORUS-KROME liner has had over 19,000 hours of operation and is still in good condition.

"Should we at any time purchase a new engine, PORUS-KROME liners will be a part of the specifications."

Evidence that PORUS-KROME *does* multiply cylinder and ring life continues to pile up. Be sure to get this greater reliability in engines you buy . . . specify PORUS-KROME. Write today for complete information.

PORUS - KROME

Good for the Life of your Engines

VAN DER HORST

U. S. PATENTS 2,048,578 AND 2,314,604

VAN DER HORST CORPORATION OF AMERICA OLEAN • NEW YORK CLEVELAND 11 • OHIO

AN AFFILIATE OF DRESSER INDUSTRIES

POWER
TO WIN
Whether it is running an oil-string, cave or water-string of pipe; hauling equipment, pumping, supplying power and light or doing the many other necessary oil field jobs that require power, you won't go wrong with Continental Red Seal Engines.
These rugged engines are designed and built for each particular job and supply dependable horse power with a minimum of maintenance.
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Awarded to the Detroit and Muskegon Plants of Continental Motors Corporation for High Achievement
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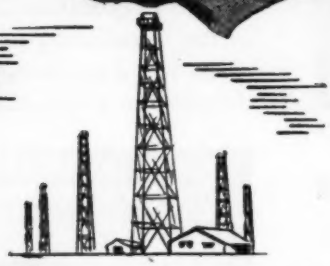


AND WELLS ARE GOING DEEPER

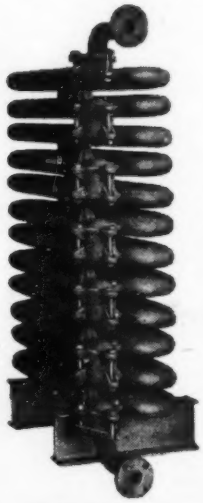
WAR reaches its climax... action's getting hotter... demand for oil is greater and greater. Fortunate that Oil Industry initiative delivers, come hell or high water. Deep drilling is a case in point... helping right now to assure the margin of supply needed for victory. Protect this vital production . . . use 'STARCOR'* for deep wells and high sulphate resistance. For deepest wells, use 'TEXCOR'*, with extra long thickening time, plus high sulphate resistance. Use 'INCOR'* for earlier drill-out in wells of moderate depth — and LONE STAR CEMENT for dependable all-around service. Four great performers — use the cement that fits your well.

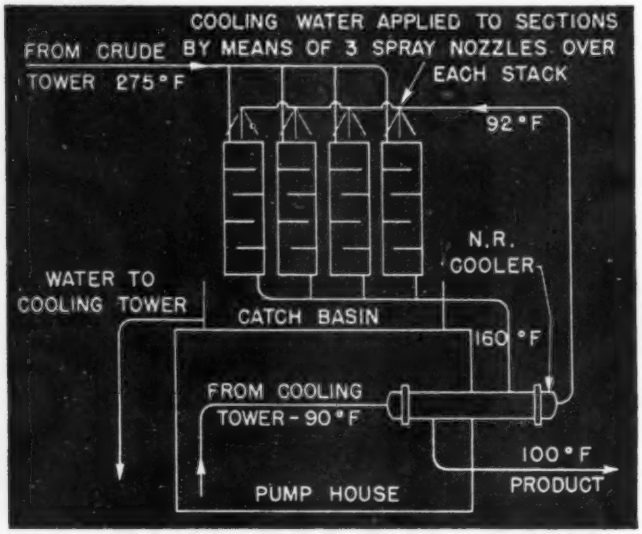
*Reg. U. S. Pat. Off.

LONE STAR CEMENT CORPORATION · DALLAS · HOUSTON

NATIONAL CONDENSING and COOLING SECTIONS take full advantage of EVAPORATIVE COOLING

A Sprayed Type National Section installation is, in effect, a heat exchanger and a cooling tower combined. High heat transfer efficiency is obtained with low water consumption.





PETROLEUM VAPOR CONDENSER

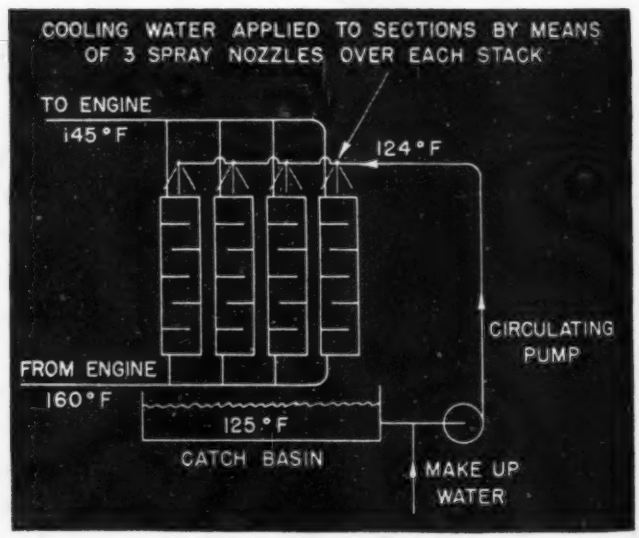
A refiner desired to increase through-put but materials were not available for enlarging his condenser or cooling tower. National engineers solved his problem by converting his condenser from a submerged to a sprayed type. All cooling water passed through an after cooler and then was sprayed onto the National Section Condenser before returning to the cooling tower. Evaporative Cooling accounted for over 33% of the condensing heat transferred and the over-all result was a decrease in the load on the cooling tower despite the substantially increased plant heat load.

ENGINE JACKET WATER COOLER

Many large gas and diesel engines are operated where cooling water is bad and costly. By adopting the system shown at the right, all heat is dissipated by evaporation so that only make up water is needed. The sections themselves are easily installed and are rugged enough for the roughest use. The sectional nature of these coolers permits easy alteration in size to meet changing conditions.

The efficiency and durability of National Sections, plus the ingenuity of National engineering can help you overcome some of your condensing and cooling problems.

Reprints of this page are available upon request.



INDUSTRIAL DIVISION

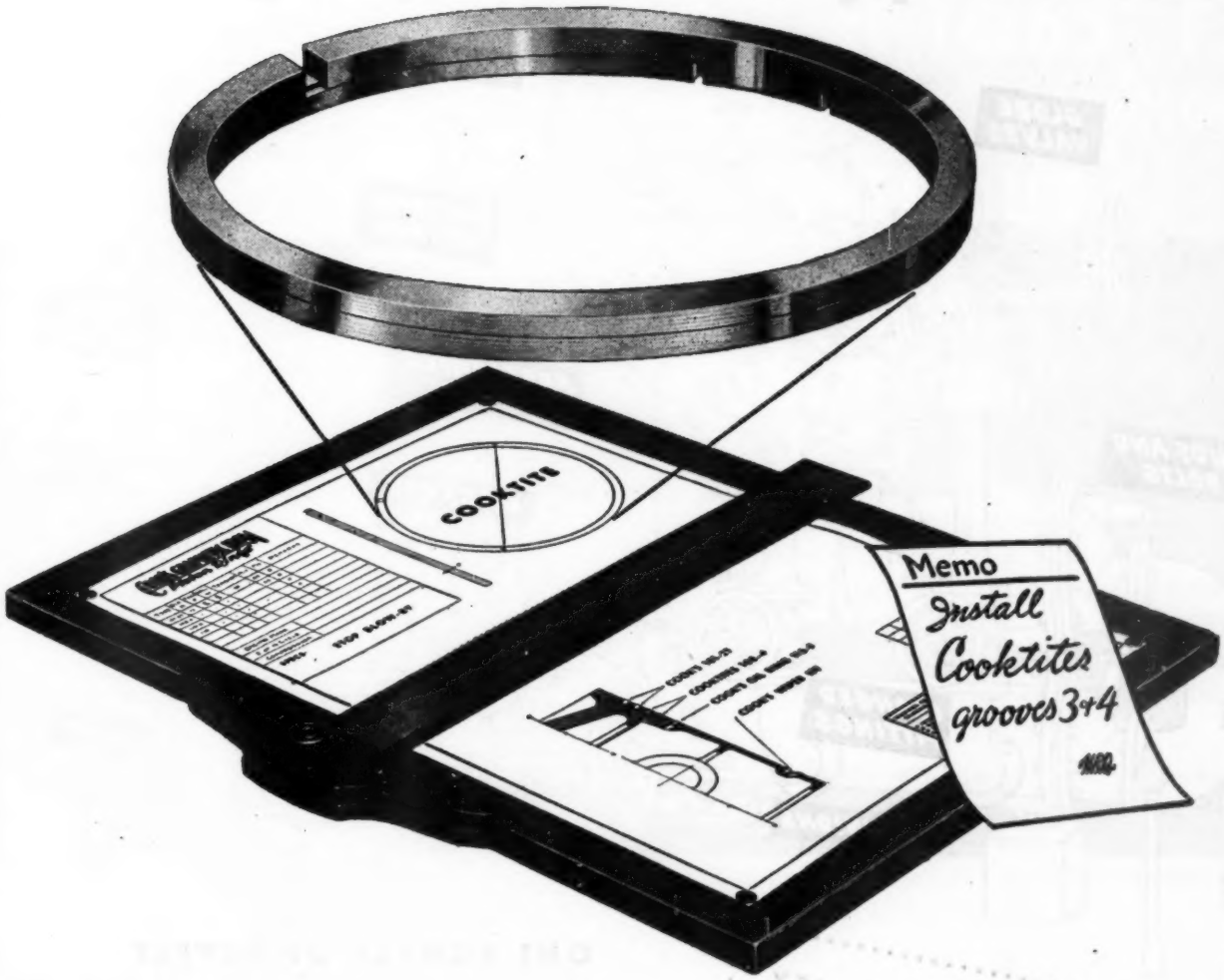
The NATIONAL RADIATOR Co.

227-S Central Avenue • Johnstown, Pa.

1894 • ESTABLISHED 50 YEARS • 1944

For "Outstanding Production Achievement"

Specs say: "Stop Blow-by"



BLOW-BY in a Diesel is a costly waste of fuel. This leakage of compression through the gap openings of ordinary rings past the piston, also breaks down the essential oil film on the cylinder walls which accelerates cylinder and ring wear.

For positive and lasting seal compression, install COOKTITES—they eliminate blow-by because there are no gap openings through which the gas can escape and they continue to function as gapless rings throughout their life.

The ever increasing use of COOKTITES, since their introduction in 1930, is evidence of their success. As one engine builder put it recently "... Since installing COOKTITES the engine develops more horsepower than it did when new."

Your Diesel, too, if it is an industrial size engine, will operate much more efficiently after the installation of COOKTITES. Usually, only two COOKTITES per piston will do the trick.

So, in preparing "Specs" to cover orders for replacement rings—or for a new engine—specify COOKTITES.

COOK'S engineers will gladly assist you in selecting the correct ring combination for your specific condition. Your inquiries are invited.

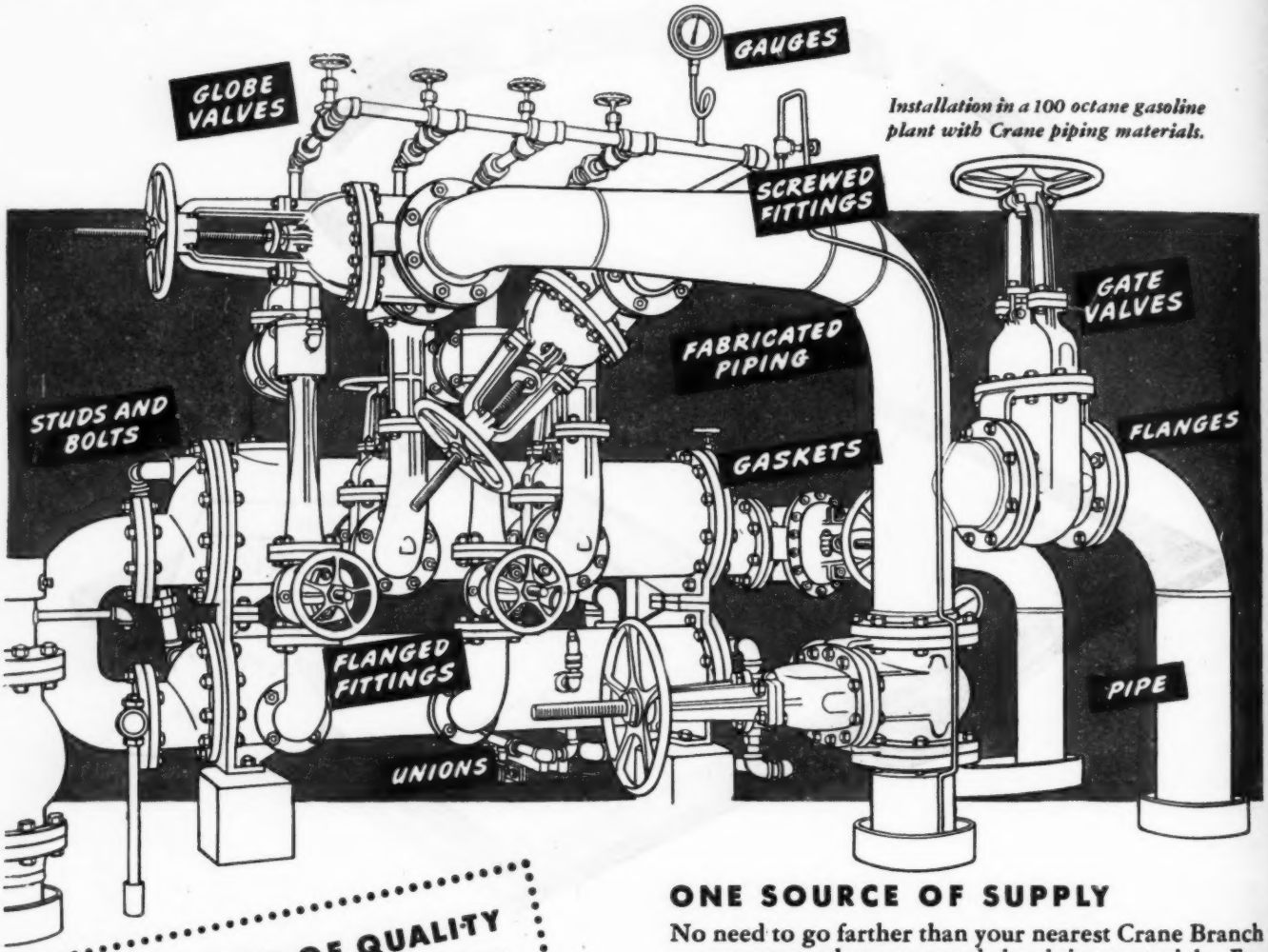
Sealing Pressures Since 1908

C. LEE COOK MANUFACTURING CO. INCORPORATED

LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

For Any Refinery Service . . . Crane Supplies All Piping Needs



Installation in a 100 octane gasoline plant with Crane piping materials.

ONE STANDARD OF QUALITY

To equip with Crane materials is to insure one high standard of quality in every part of piping systems. Such quality is exemplified in Crane Iron Body Wedge Gate Valve design. Strong body sections resist severest strains. Straight-through ports give streamline flow. A deeper stuffing box lengthens packing life. Extra long guides keep disc true, while balanced stem design maintains smooth and positive operation.

STANDARD IRON BODY WEDGE GATE VALVES

ONE SOURCE OF SUPPLY

No need to go farther than your nearest Crane Branch — no matter what your needs in piping materials. For power or processing systems—for high, moderate, or low pressure—valves, fittings, pipe, fabricated assemblies—all essential parts to the last accessory, are supplied by this single source. You choose to your exact requirements from the world's greatest line of piping equipment.

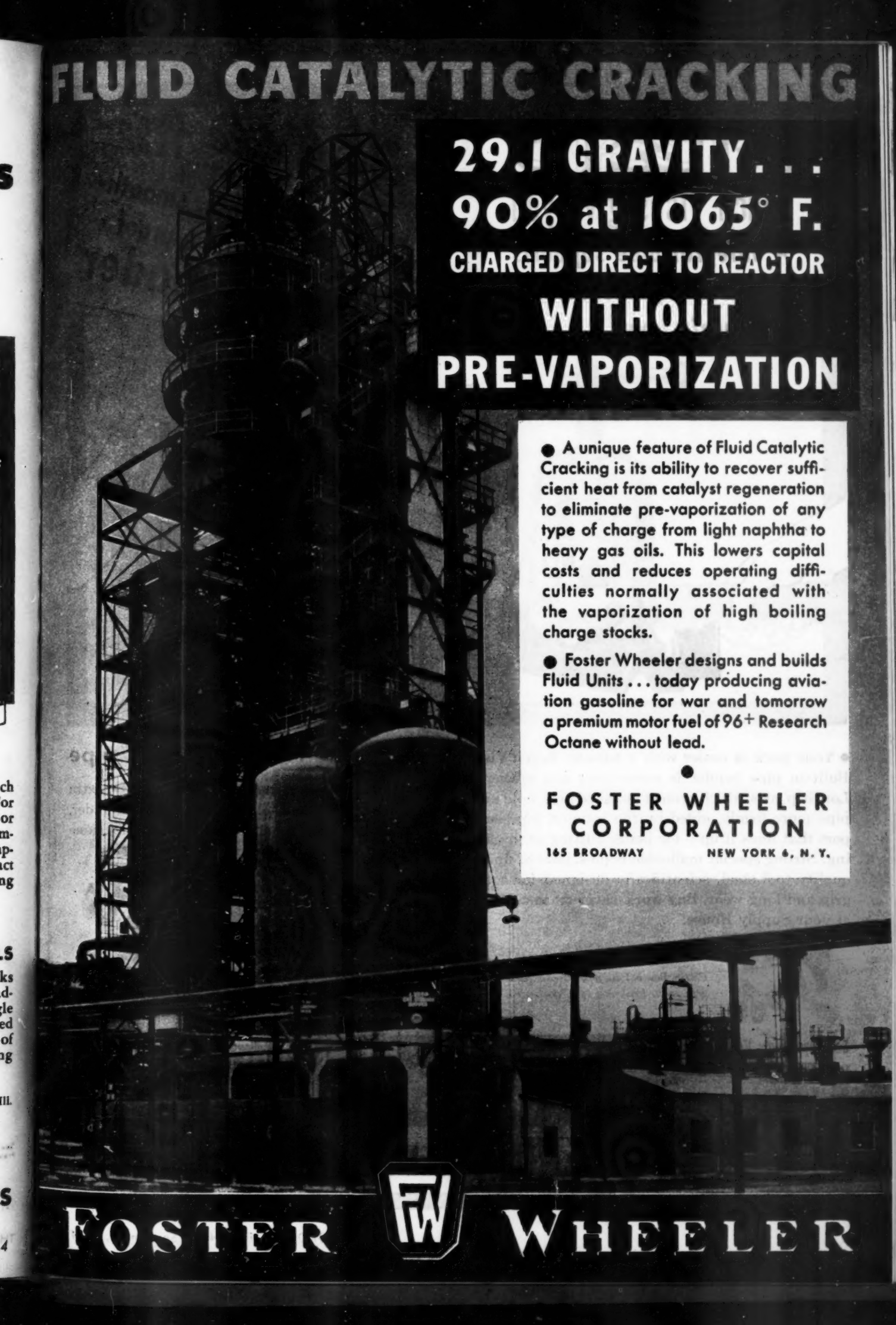
ONE RESPONSIBILITY FOR ALL MATERIALS

Ordering—maintenance work—keeping of parts stocks —all such operations are simplified when you take advantage of Crane *complete* materials service. Single responsibility for quality and craftsmanship is reflected in better installations. You gain all the benefits of Crane Co.'s 89 years of leadership in the piping equipment field.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS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29.1 GRAVITY . . .
90% at 1065° F.
CHARGED DIRECT TO REACTOR
WITHOUT
PRE-VAPORIZATION
● A unique feature of Fluid Catalytic Cracking is its ability to recover sufficient heat from catalyst regeneration to eliminate pre-vaporization of any type of charge from light naphtha to heavy gas oils. This lowers capital costs and reduces operating difficulties normally associated with the vaporization of high boiling charge stocks.
● Foster Wheeler designs and builds Fluid Units . . . today producing aviation gasoline for war and tomorrow a premium motor fuel of 96+ Research Octane without lead.
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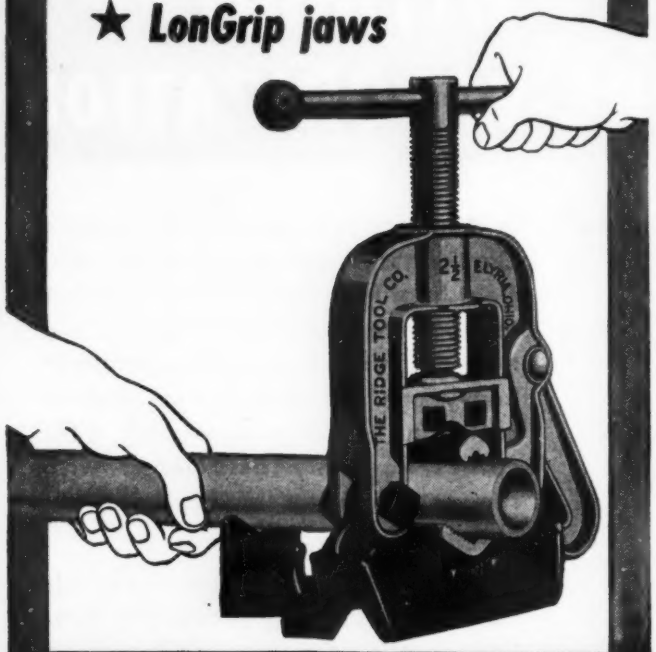
RIDGID

Bench Vises give you

★ *Integral pipe supports*
★ *Handy pipe benders*
★ *LonGrip jaws*



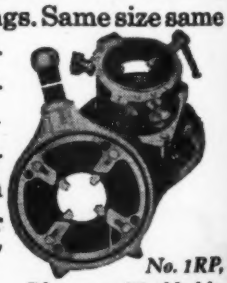
● Your work is easier with a RIDGID Bench Vise. Built-in pipe bender is convenient and efficient. LonGrip jaws, which protect polished pipe, hold any pipe more firmly, aided by the integral pipe support that lines it up — for better cutting or threading. Strong special malleable bodies, jaws of finest quality tool steel, scientifically designed for solid grip and long wear. Buy work-saver RIDGID Vises at your Supply House.

Chain Bench Vise with streamlined solid-grip jaws. Five sizes to 8" capacity.

You'll like this unusually fast, smooth-working, mistake-proof Poster Threader

RIDGID No. 1RC—1" to 2" pipe

● Without extra cost RIDGID Poster gives you extra work-saver features. Mistake-proof workholder, quick positive setting—no bushings. Same size same number chaser dies are interchangeable. Direct threading action, handle to head to chasers—no cock-wobble. Rugged steel-and-malleable construction. Smooth perfect threads, 4 sets of alloy or high-speed steel dies for 1" to 2" pipe. Ask your Supply House.

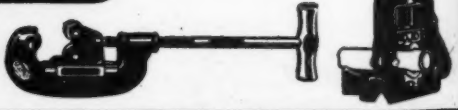


No. 1RP, Plate-type Workholder

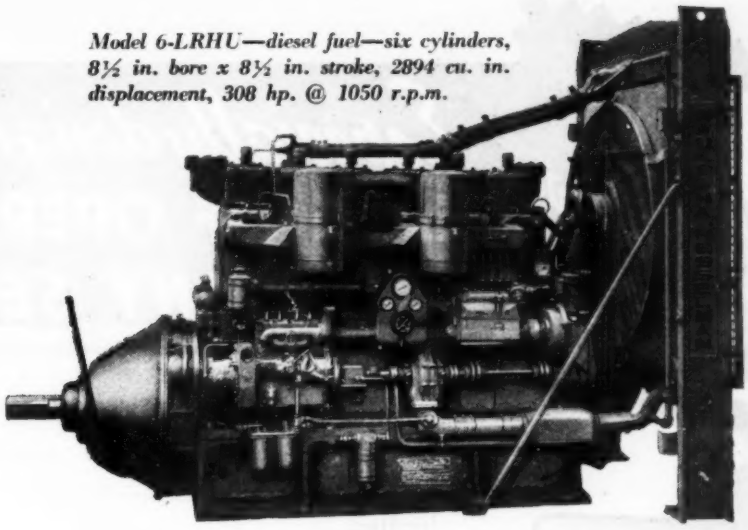
Sold by Supply Houses Everywhere

Millions of RIDGID Tools in use

RIDGID
★ PIPE TOOLS ★



THE RIDGE TOOL COMPANY
Elyria, Ohio, U. S. A.



Model 6-LRHU—diesel fuel—six cylinders, 8½ in. bore x 8½ in. stroke, 2894 cu. in. displacement, 308 hp. @ 1050 r.p.m.

WIDER ADAPTABILITY
IN DRILLING

• This is the one drilling engine that not only burns high-speed diesel fuels . . . of either high or low cetane . . . but Nos. 1, 2 or 3 domestic furnace oils just as efficiently. And it's even more adaptable . . .

As drilling progresses . . . and gas is struck . . . this engine can switch over to burning natural gas. An hour's time does the whole job—like this . . .

Apply a gas carburetor . . . and gas spark plugs . . . replace injectors with blind plugs . . . unbolt fuel pump coupling—and it's all set to go. Not one major part has to be changed!

With this engine are these other advantages: • Mounted directly on the power plant is a small 4-cylinder gasoline engine starting unit . . . giving it high sustained cranking ability. • A heavy-duty clutch for direct connection to the rig drives. • Rugged radiator, with fan fully protected by heavy wire guard and shroud. • Oil coolers and automatic safety control give greater dependability and protection against low oil and overheating. For complete details, *get Bulletin 1116.*

MORE POWER FOR VICTORY

WAUKESHA
HESSELMAN *Oil* ENGINES

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN • NEW YORK • TULSA • LOS ANGELES

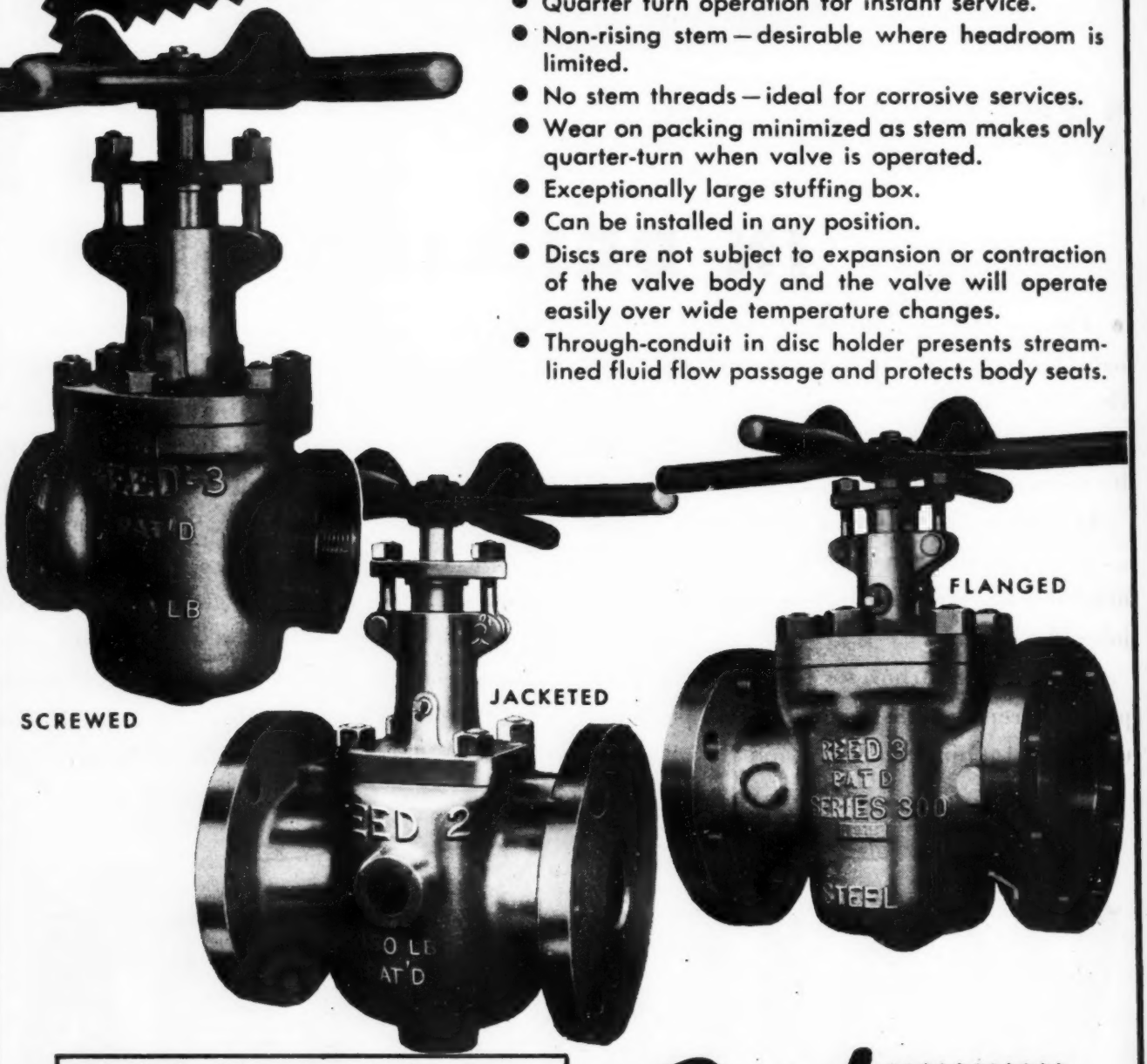
REED

Quarter-turn Double Disc Gate

VALVES

Especially designed for EASE OF OPERATION *IN ANY SERVICE!*

- Positive position indication at all times.
- Quarter turn operation for instant service.
- Non-rising stem — desirable where headroom is limited.
- No stem threads — ideal for corrosive services.
- Wear on packing minimized as stem makes only quarter-turn when valve is operated.
- Exceptionally large stuffing box.
- Can be installed in any position.
- Discs are not subject to expansion or contraction of the valve body and the valve will operate easily over wide temperature changes.
- Through-conduit in disc holder presents streamlined fluid flow passage and protects body seats.



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4F-6

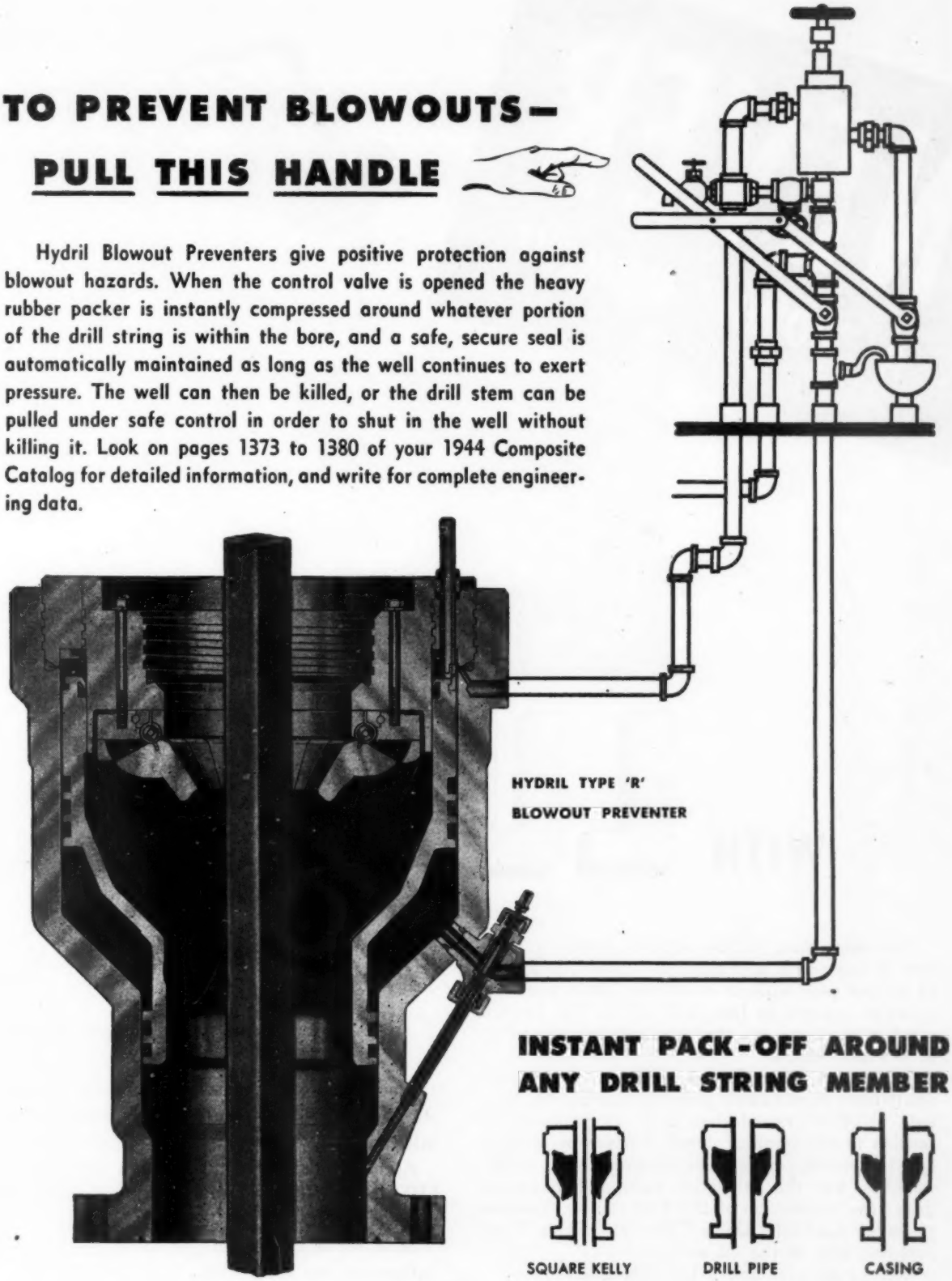
Reed VALVE DIVISION

ROLLER BIT COMPANY

HOUSTON 1, TEXAS

TO PREVENT BLOWOUTS—
PULL THIS HANDLE

Hydril Blowout Preventers give positive protection against blowout hazards. When the control valve is opened the heavy rubber packer is instantly compressed around whatever portion of the drill string is within the bore, and a safe, secure seal is automatically maintained as long as the well continues to exert pressure. The well can then be killed, or the drill stem can be pulled under safe control in order to shut in the well without killing it. Look on pages 1373 to 1380 of your 1944 Composite Catalog for detailed information, and write for complete engineering data.



HYDRIL TYPE 'R'
BLOWOUT PREVENTER

INSTANT PACK-OFF AROUND ANY DRILL STRING MEMBER

SQUARE KELLY | DRILL PIPE | CASING

HYDRIL

HYDRIL COMPANY • 714 WEST OLYMPIC BLVD. • LOS ANGELES 15, CALIF.

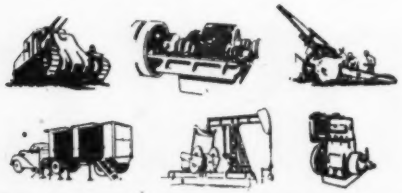
NEVER
A "DOWN" MOMENT

WITH LUFKIN

The more than 12,000 LUFKIN Pumping Units now in use pump approximately 9,000,000 barrels of oil per year without a moment *down time* because of repairs. In fact, LUFKIN's Parts Department sales are so low they scarcely pay the salary of the storekeeper.

The reason is simple — LUFKIN engineers have spent more than twenty years developing the present "LUFKIN" trouble-free unit — Experience, attention to the smallest detail, modern metallurgical laboratory, modern production tools, skilled workmen and the entire job built and assembled under the supervision of LUFKIN experts, combine to make LUFKIN Units "The No Down-Time" pumping unit of the oil world.

Make your next unit a LUFKIN UNIT.



In addition to the producing on a "round the clock" 24 hour basis, tank gears, ship gears, gun carriages and truck trailers for our armed forces we are also producing in ever increasing number, LUFKIN PUMPING UNITS and COOPER-BESSEMER ENGINES for America's vital oil industry.

Here's a Lufkin Plan

WHICH MAY HELP YOU!

Place your orders now for your postwar needs. No down payment—no deposit necessary. We only ask that your order be placed in good faith.

As materials and manpower are released, your LUFKIN EQUIPMENT will be shipped in the order received.

Send for a Lufkin catalog today. Pick out the equipment you need. Place your orders now!

LUFKIN
PUMPING UNITS

LUFKIN FOUNDRY & MACHINE COMPANY • LUFKIN, TEXAS

Dependable power in the making . . . grinding the crankshaft of LEROI valve-in-head engine

TURN THE PAGE

LE ROI

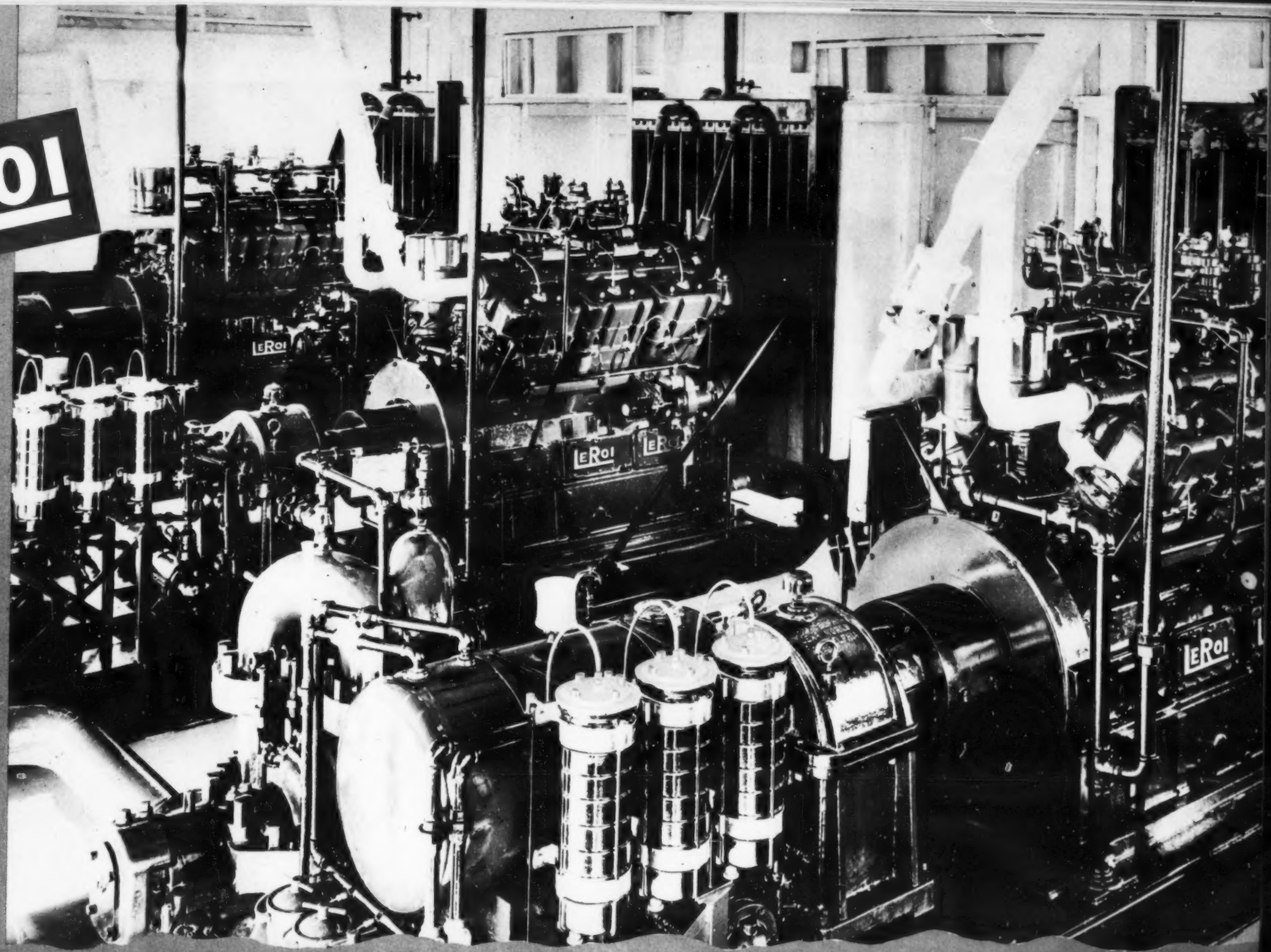
Engines

DRIVING MULTI-STAGE CENTRIFUGAL

Pipe Line Pumps

that handle 116,000 barrels of oil per day under normal conditions. These pumps are in continuous operation, dependably powered with four RX1SV Le Roi Engines.

ON THE REVERSE SIDE—One of the skilled craftsmen at Le Roi grinding a crankshaft to extremely close tolerance. This same exacting care is in evidence on all machining operations, assuring you of a vibrationless



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Southern Engine & Pump Company, Houston, Dallas, Kilgore, Tex.
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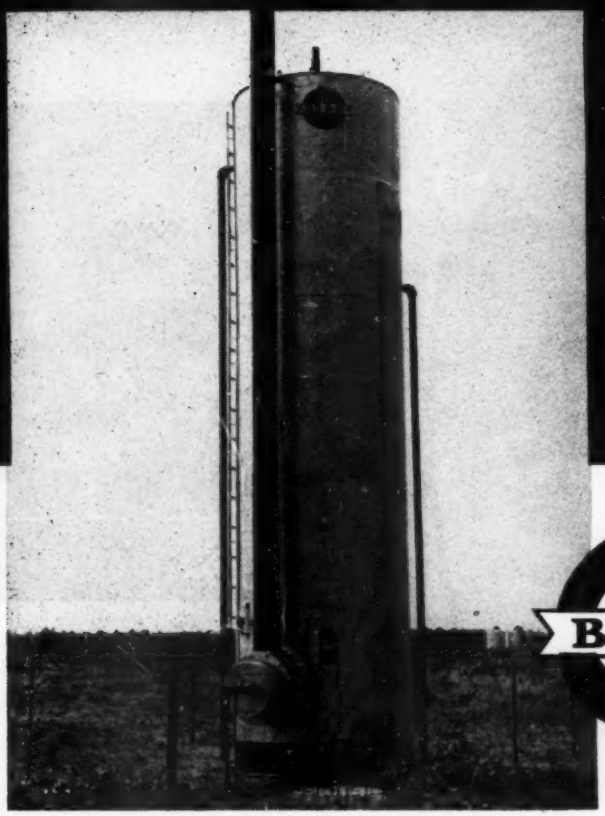
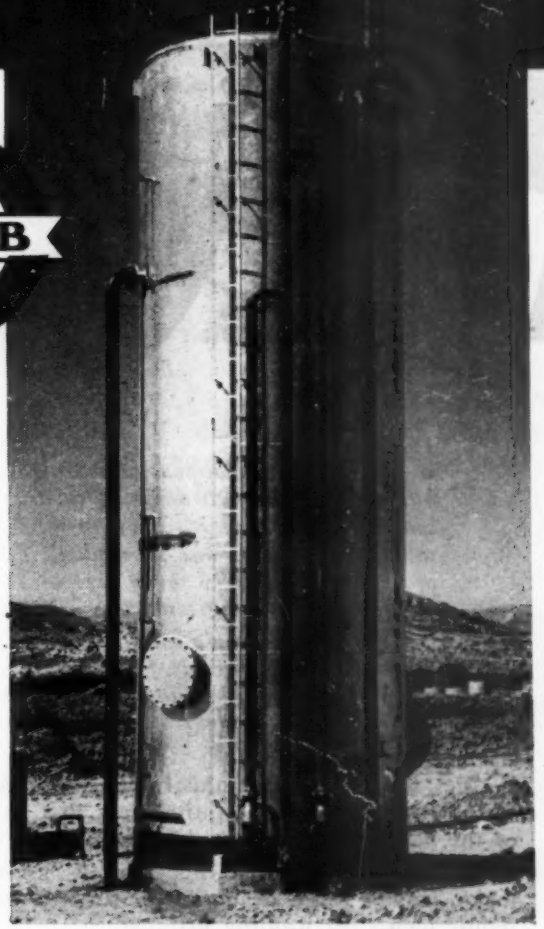
OIL IS AMMUNITION

TREAT IT ECONOMICALLY AND EFFICIENTLY WITH

B S & B STAGE TREATERS



6' x 24' Treater in Texas



8' x 24' Treater in Wyoming

BS&B STAGE TREATERS ARE DESIGNED TO:

1. Separate, before heating, all FREE gas in the oil and emulsion.
2. Separate, before heating, all FREE water in the free water knock-out.
3. Heat the emulsion to required treating temperature and automatically control this temperature.
4. Separate all gas, liberated by heating before final settling occurs.
5. Discharge, to stock tanks, relatively cool oil.
6. Permit intimate mixing of HOT gas, liberated by heating, with COLD gas from primary separation, thus returning condensables to the settling chamber.
7. Settle out the last small percentage of water by quiet settling.

Available in Several Sizes and Working Pressures for any Oil Treating Job. Investigate before the Winter Treating Season is upon you.

Write for Literature

Ask Your B S & B Man

Black, Sivalls & Bryson (INC.)

OKLAHOMA CITY

"When bigger stub ends are built"...

• *As you know, Lapped-joint Stub Ends are standardized only in pipe sizes through 24 inches. In this range thousands are used, but it's only on rare occasions that a real whopper like this one is needed. It's a seamless carbon-moly forging nearly seven feet in outside diameter and about two feet long with 1½ inch wall thickness.*

Obviously, we aren't soliciting orders for 84 inch O.D. Lapped-joint Stub Ends. However, when "specials" of this kind are needed, it's a good bet that the job will be turned over to Taylor Forge.

Yes, for many years industry has considered Taylor Forge headquarters for those forging requirements that call for *unusual* knowledge of the behavior of hot metal under pressure and impact.

And isn't it true that this *unusual* "know-how" and facilities also make Taylor Forge headquarters for *unusual value* in your standard requirements for welding fittings?

You can be sure that it does, and if you want further confirmation you can find it in the features of WeldELLS listed opposite.

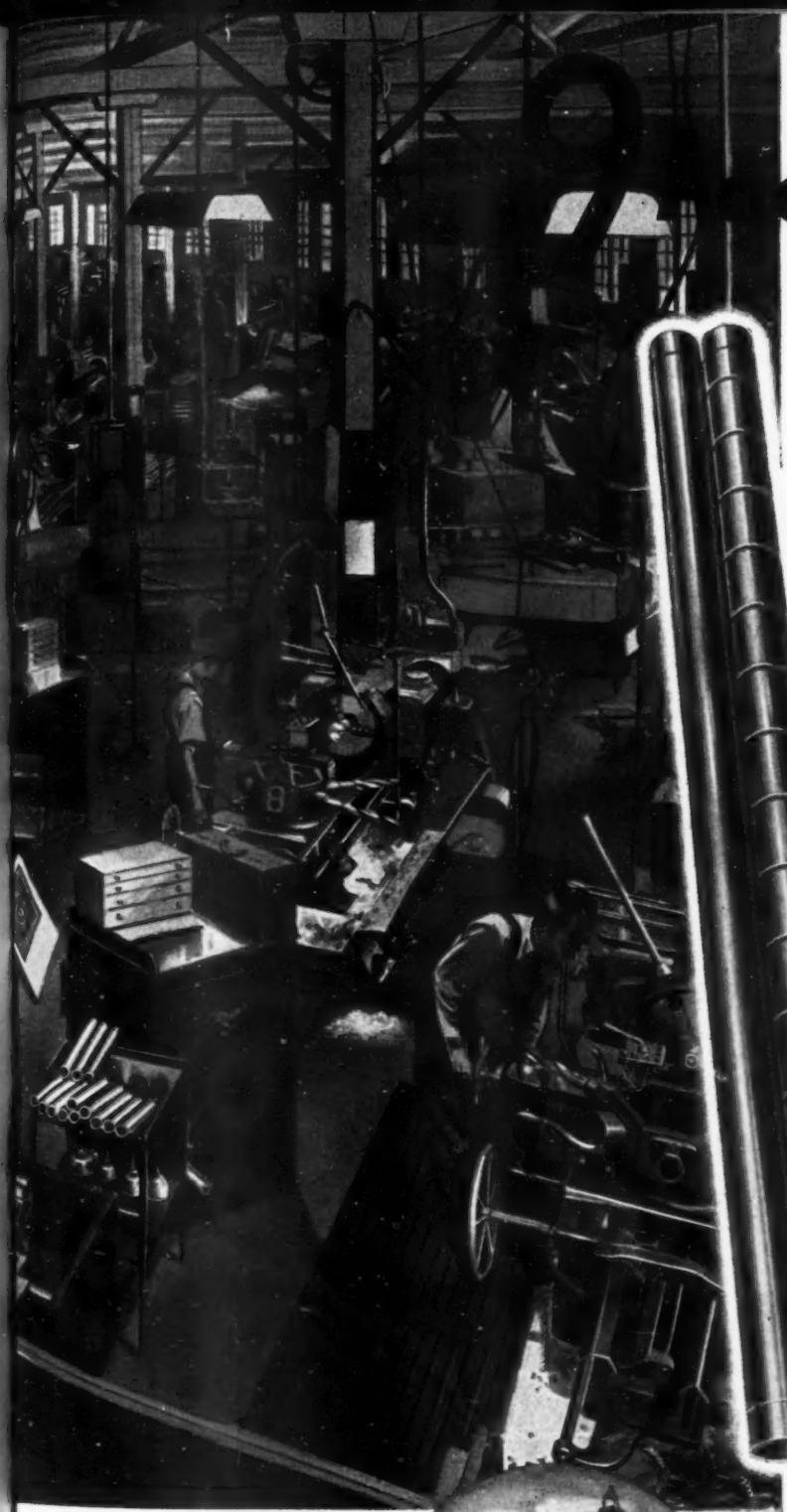
You will find features that are not combined in any other welding fittings . . . extra reinforcement where stresses are greatest . . . ample tangents . . . extremely accurate dimensions . . . permanent identifications . . . precision quarter marked ends. In short, you will find that

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



es of Precision

HERE, under one roof, is arrayed the world's greatest mobilization of machine tool equipment for manufacturing deep well plunger pumps. Manned by skilled veterans who know their product and what is expected of it, this machine tool equipment represents the zenith in scientific metal working. These men and machines, working together to maintain uniform quality with volume production, have established Axelson's reputation as the leading builder of sub-surface oil well pumping equipment.

Pioneering accuracy and precision, both in casting and machining, Axelson made possible the interchangeable liner pump—set the pace for present international petroleum pumping progress.

In fifty years of producing deep well plunger pumps, Axelson has incorporated numerous "firsts" in design, engineering and better manufacturing processes. These firsts have been stepping stones to new developments, new methods, new products—widely imitated but never duplicated.

Axelson's 9 acres of plant precision is your guarantee of satisfaction when you specify pumping products bearing the Ⓐ.

AXELSON MANUFACTURING COMPANY

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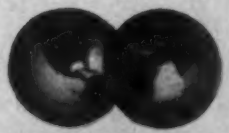
Axelson manufactures the industry's most complete line of deep well plunger pumps and sucker rods. Interchangeability of precision-made parts permits combinations of pumping equipment to scientifically handle every type of oil field production problem.

AXELSON

ORIGINATORS OF

INTERCHANGEABLE LINER PUMPS



FOR INTERNATIONAL SERVICE

HOW TO *extend* THE LIFE OF WIRE LINES

The almost universal acceptance of the PATTERSON-BALLAGH WIRE LINE GUIDE by the oil industry indicates that this method of guiding the wire line onto the drum fills an urgent need.

The basic operating principle of this device is that a freely hanging, heavy, rubber-lined cylinder will damper the whip and iron out the "traveling wave." The rubber lining, in sections, is grooved internally to hold the lubricant. These easily replaceable sections are the only wearing parts, making the operating costs nominal.

By stabilizing the lines with PATTERSON-BALLAGH WIRE LINE GUIDES, fatigue, corrosion, kinks, strand separation, surface wear and poor spooling are minimized. Drilling and wire line speeds can be increased—the life of the line being extended from 10% to 50%. Operations are safer.

PATTERSON-BALLAGH

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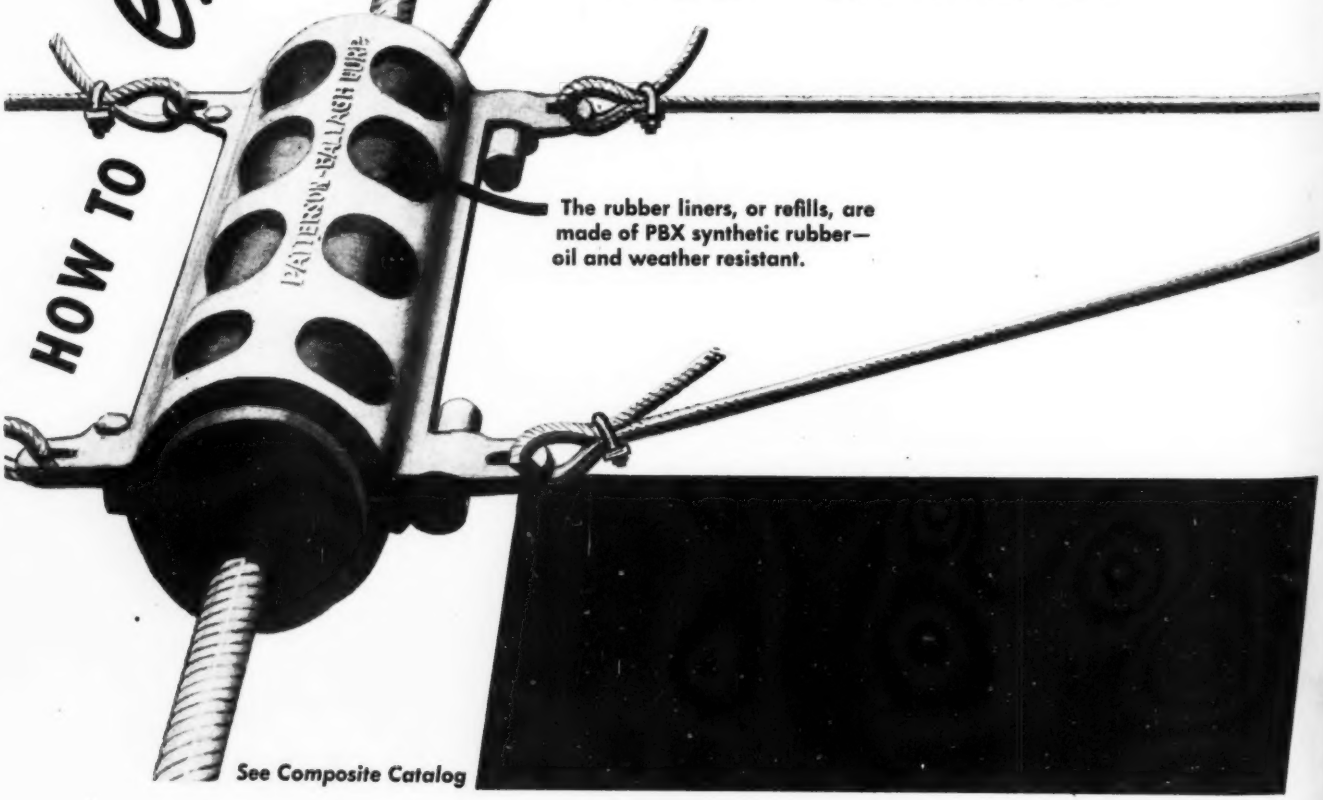

The rubber liners, or refills, are made of PBX synthetic rubber—oil and weather resistant.

See Composite Catalog

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The Hunt Wire Line Barrel requires less inventory to maintain it because of fewer parts . . . easy to repair right on the rig by our own crew . . . more economical to operate because of simplicity of design. If it's wire line coring, demand the Hunt Barrel.

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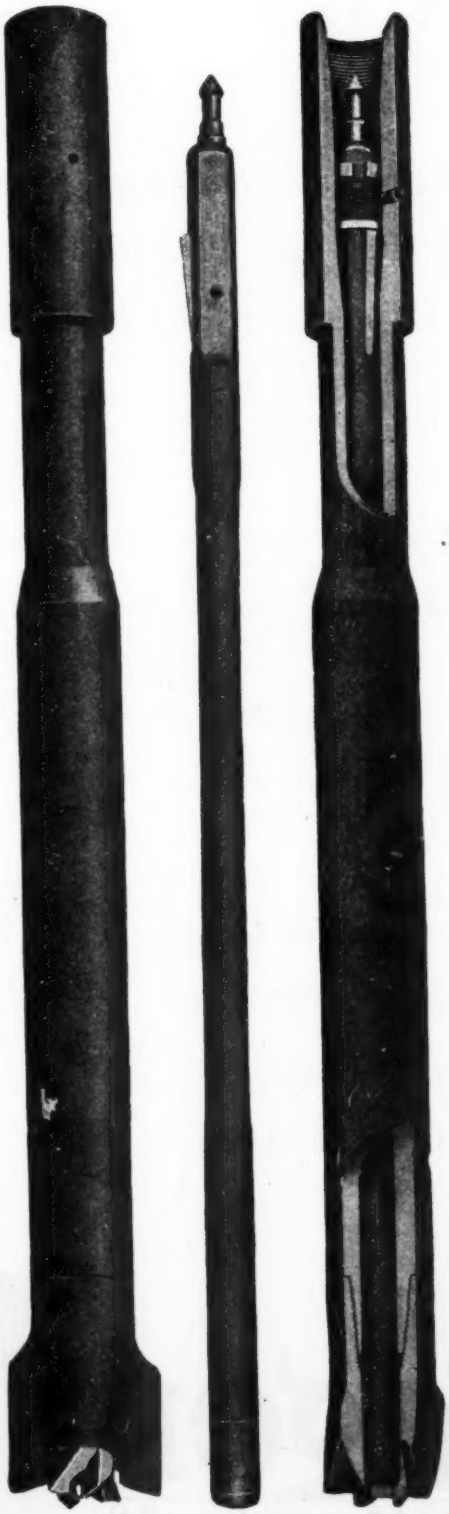

Core Bit and Drill Collar assembled

Core Barrel assembly

Showing barrel in place for cutting

3-way box type core bit

2-way box type core bit

4-cutter hard formation coring head

The stage is set...and you are "ON THE PROGRAM"

Industry demands increased production of butanes and propane—calling for super-fractionating equipment for more selective recovery of the lighter hydrocarbons. There is now full recognition of need for gas dehydration units to condition natural gas for Pipe Line delivery.

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Natural Gasoline and Recycling Plants on a turnkey basis, as complete units operating at proper efficiency. ENGINEERING, including design and processing work; FABRICATION of special equipment in our own shops; CONSTRUCTION, with our own personnel and equipment.

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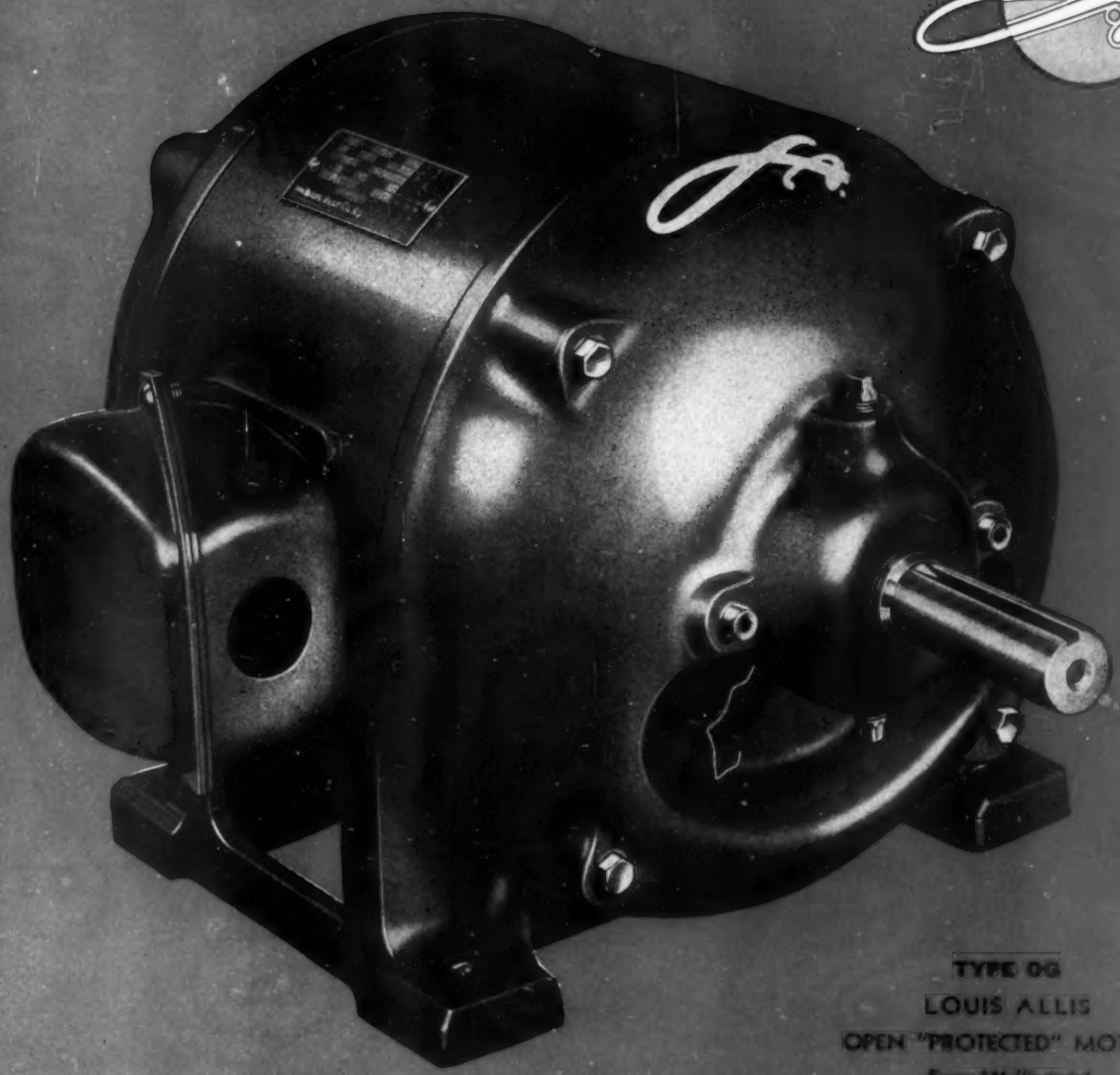

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OPEN "PROTECTED" MOTORS
Frame 225 Illustrated

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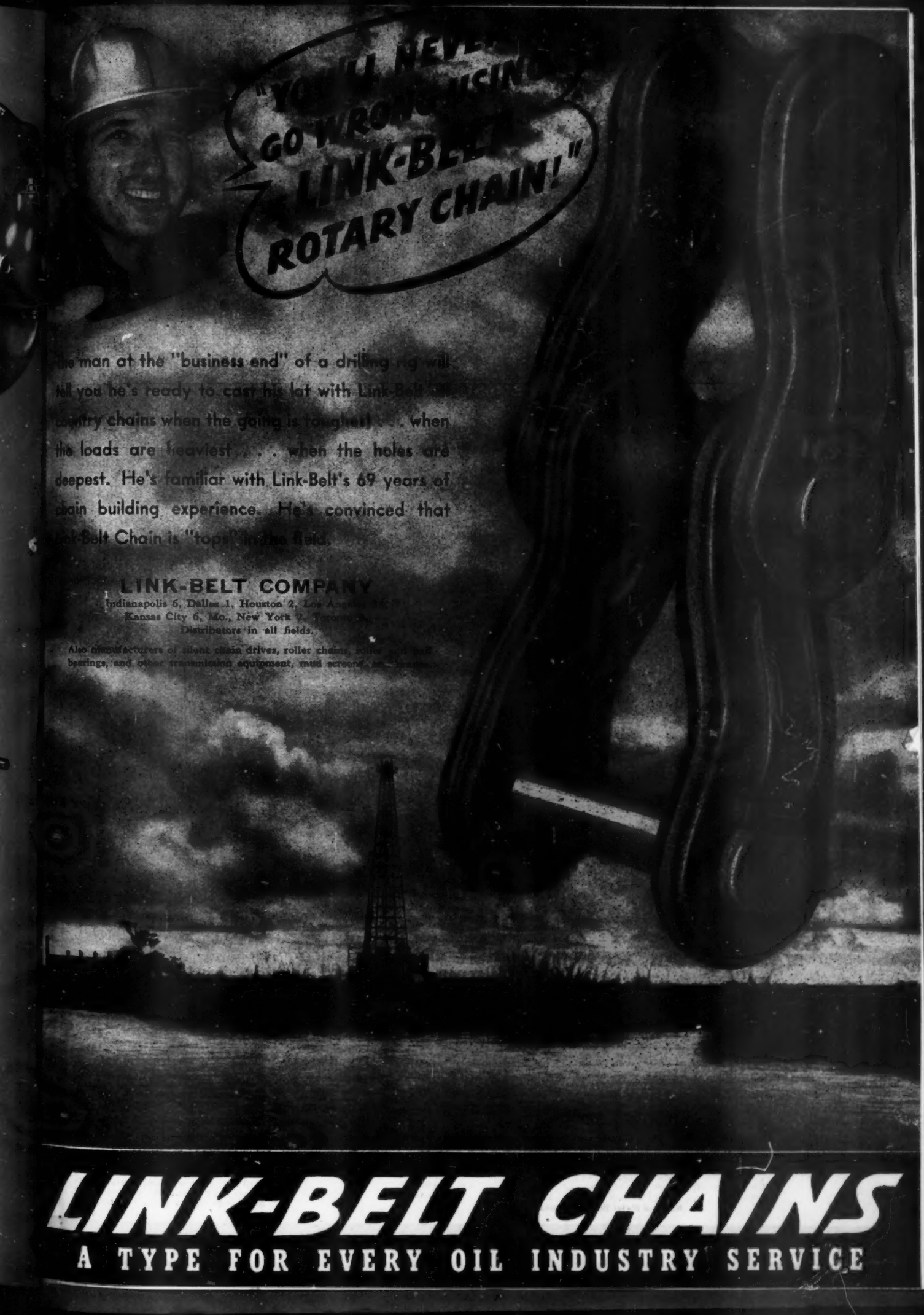
Fourteen points of in-built quality construction are pointed out in the above disassembled view. Upon request a copy of new fully descriptive bulletin will be sent.

THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.



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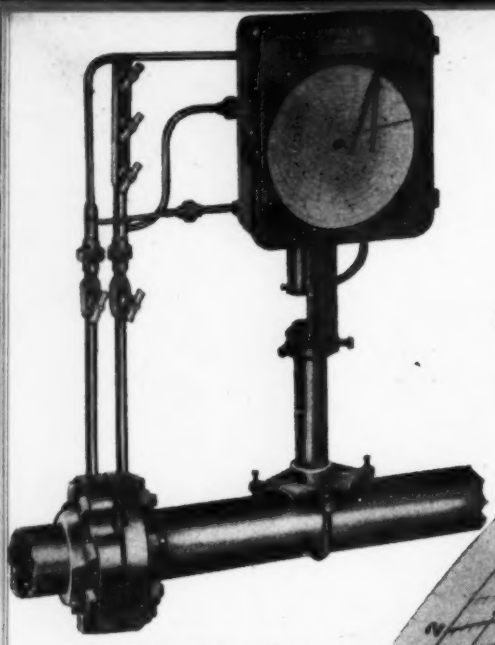
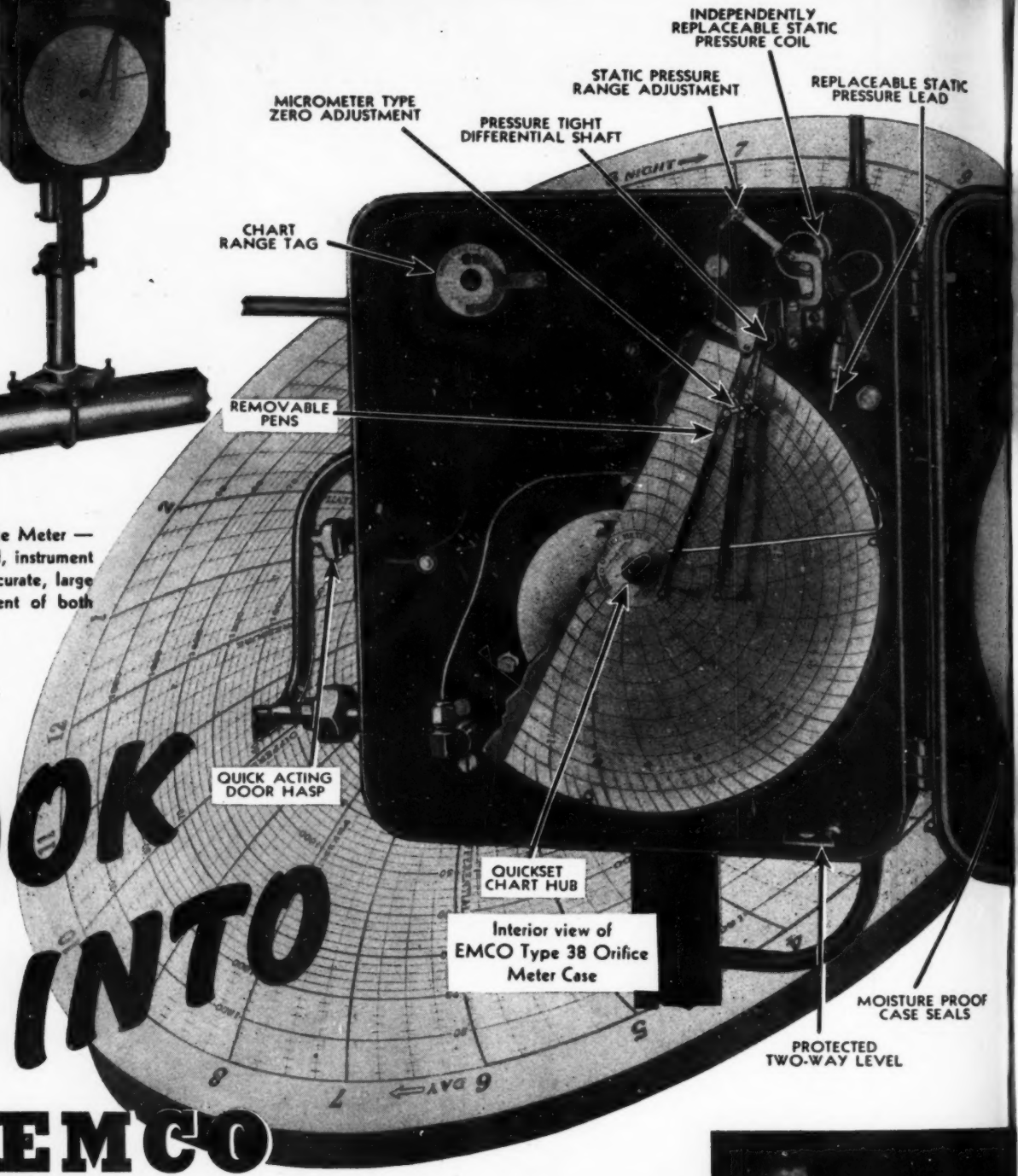
A TYPE FOR EVERY OIL INDUSTRY SERVICE



The EMCO Orifice Meter — a compact, rugged, instrument style meter for accurate, large volume measurement of both liquids and gases.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REMOVABLE PENS
QUICK ACTING DOOR HASP
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Interior view of EMCO Type 38 Orifice Meter Case
MOISTURE PROOF CASE SEALS
PROTECTED TWO-WAY LEVEL

LOOK INTO

THE EMCO *type 38 ORIFICE METER*

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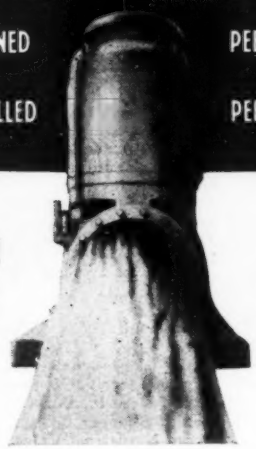

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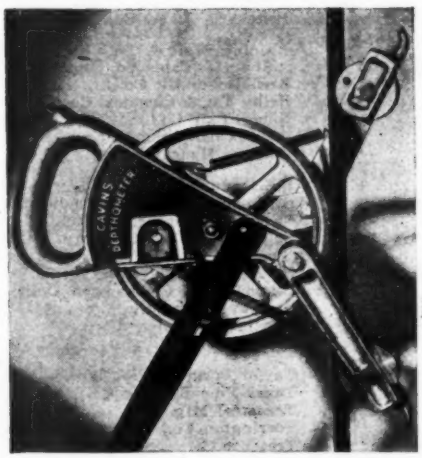
PEERLESS
Deep Well Pumps

THE CAVINS DEPTHOMETER
For Wire Line Depth Measurements



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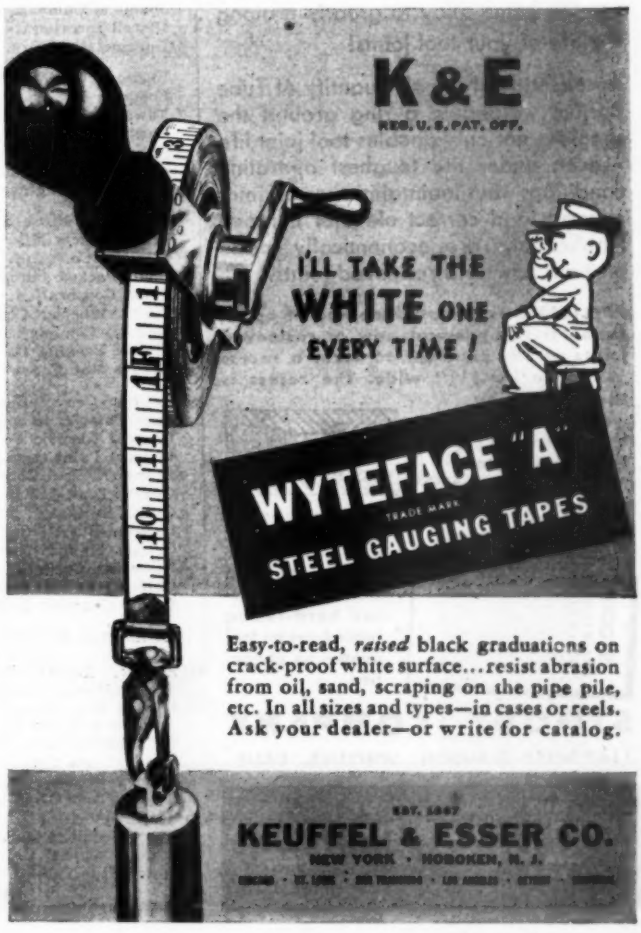

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Doubles tool joint life

For fifteen years Tube Borium has been used on drilling bits to increase cutting speeds and drill more out-to-gauge hole. Now you can use this same alloy to greatly prolong the life of your tool joints!

An exceedingly small quantity of Tube Borium welded in a ring around the shoulder not only doubles tool joint life—even under the toughest operating conditions—but maintains over all joint strength and correct elevator contour. Applications are economically made on both new and resleeved joints.

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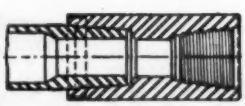

Write for this special Stoody engineering bulletin describing in detail hard-facing procedures on tool joints—no obligation.

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Retard wear... Save Repair

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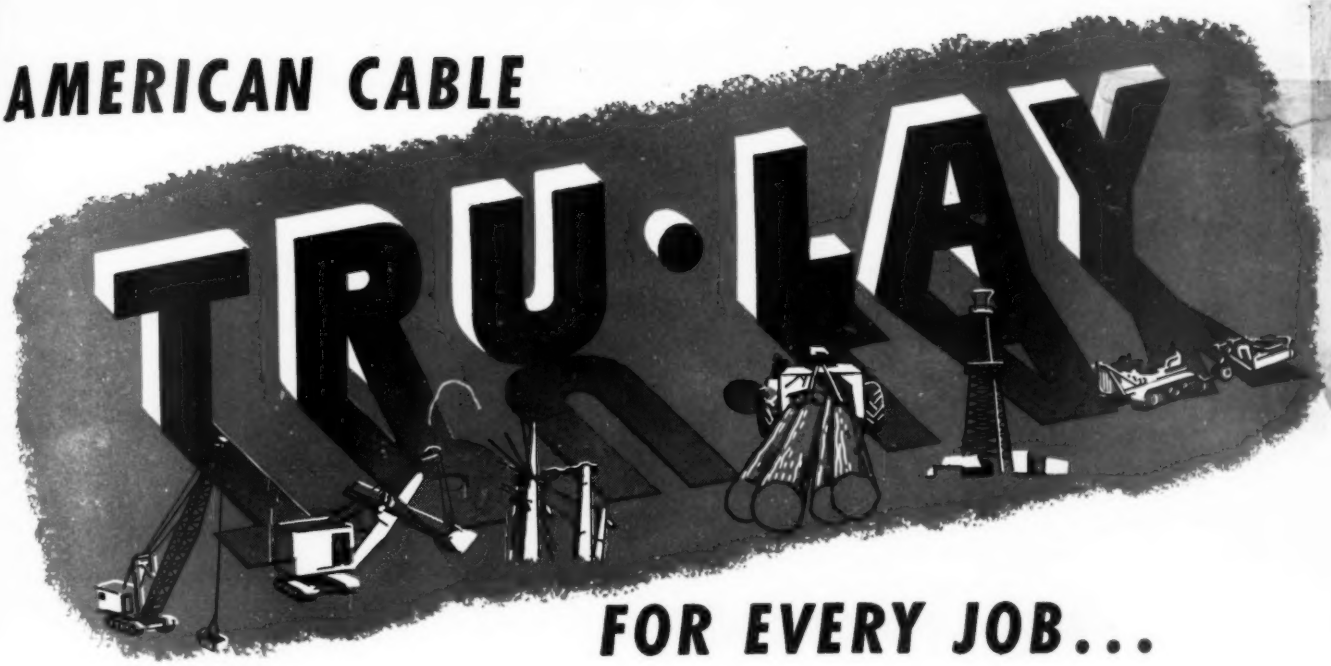

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